

## Chapter 4

Steve Hillebrand/USFWS



*Great blue heron*

# Environmental Consequences

- Introduction
- Chapter Organization
- Regional Scale Impacts
- Refuge-specific Impacts
- Cumulative Impacts
- Relationship Between Short-term Uses of the Human Environment and Enhancement of Long-term Productivity
- Unavoidable Adverse Effects
- Potential Irreversible and Irretrievable Commitment of Resources
- Environmental Justice
- Summary of the Impacts of the Alternatives

## Introduction

This chapter describes the foreseeable environmental consequences that we predict from implementing the refuge management alternatives presented in chapter 3. Specifically, we predict the beneficial and adverse effects of implementing the management actions and strategies for each of the alternatives:

- **Alternative A**–“Current Management” (which serves as a baseline for comparing against the other two alternatives)
- **Alternative B**–“Emphasis on Habitats and Focal Species” (Service-preferred)
- **Alternative C**–“Emphasis on Natural Processes”

In this chapter, we describe the direct, indirect, short-term, and cumulative influences of effects likely to occur over the 15-year life span of this CCP. Beyond the 15-year planning horizon, we give a more approximate description of environmental consequences. Where detailed information is available, we present a scientific and analytic comparison of the alternatives and their anticipated impacts and effects on the environment. When detailed information is not available, we base those comparisons on our professional judgment and experience. At the end of this chapter, table 4.2 summarizes the effects predicted for each alternative and provides a side-by-side comparison. Our discussion also relates the predicted impacts of the alternatives to the refuge goals and the key issues identified in chapter 1.

The Council for Environmental Quality (CEQ) and Service regulations on implementing NEPA require that we assess the significance of the effects of all alternatives based on their context, duration, and intensity. The context of our impact analysis ranges from site specific to regional and landscape-scale, depending on how widely the effect of an action can be observed. Certain actions (such as removal of invasive plant species) may have effects only in a very local context, while others (such as participation in regional partnerships) may have effects in a much broader context (see table 4.1). However, it is important to note that even local actions may have cumulative effects in a larger context, when combined with other actions. For example, invasive plant control on a local scale, when combined with other control efforts across that landscape, could result in combined, significant effect by reducing the overall abundance and distribution of invasive species. Although the refuge is only a small percentage of the larger ecoregion, we developed the three management alternatives to contribute toward regional conservation goals. Our proposed conservation objectives and strategies for species and habitats are consistent with regional, State, and Service landscape-level plans identified in chapter 1, including the PREP Management Plan, NHWAP, and the BCR 30 Plan.

We based our evaluation of the intensity of the effects from implementing the alternatives on these factors:

- The expected degree or percent of change in the resource from current conditions
- The frequency and duration of the effect
- The sensitivity of the resource to such an effect, or its natural resiliency to recover from such an effect



Steve Hillebrand

*Beaver with branch*

- The potential for implementing effective preventive or mitigating measures to lessen the effect

Effects range in duration from short-term (a matter of days or weeks, as with noise produced by construction) to effectively permanent (e.g., dam and other structure removal).

Finally, we consider the

- cumulative effects;
- relationship between short-term uses of the human environment and the enhancement of long-term productivity;
- the potential irreversible and irretrievable commitments of resources; and
- environmental justice impacts.

We do not fully evaluate the environmental impacts of certain proposed projects in this chapter. These include aspects of management that are both common to all alternatives and do not individually or cumulatively have a significant effect on the quality of the human environment. The following would qualify for exclusion under the Service's list of categorical exclusions, if individually proposed:

- Environmental education and interpretive programs (unless major construction is involved or significant increase in visitation is expected)
- Research, resource inventories, monitoring, and other resource information collection
- Operations and maintenance of existing infrastructure and facilities (unless major renovation is involved)
- Certain minor, routine, recurring management activities and improvements

- Small construction projects (e.g., fences, kiosks, interpretive signs, and RV pad)
- Native vegetation planting and invasive plant control
- Minor changes in amounts and types of public use
- Issuance of new or revised management plans when only minor changes are planned
- Law enforcement activities

We describe in chapter 3, under the heading “Additional NEPA Analysis,” those future management decisions that may require more detailed analysis before a choice is made. We analyze the impacts of available choices in this document to the extent possible, but more detailed analysis will inform the final choice.

## Chapter Organization

Our analysis first focuses on broad, regional-scale impacts, then examines more refuge-specific impacts. The chapter is organized as follows:

- Regional-scale Impacts
  - ✱ Air quality
  - ✱ Hydrologic systems and water quality
  - ✱ Socioeconomic resources
- Refuge-specific Impacts
  - ✱ Soils
  - ✱ Vegetation
  - ✱ Migratory birds
  - ✱ Fish
  - ✱ Threatened and endangered species
  - ✱ Biological integrity, diversity, and environmental health
  - ✱ Public uses and access
  - ✱ Cultural resources

Under each heading we discuss the resource context, benefits, and adverse impacts of management actions that would occur regardless of which alternative is selected, and finally the benefits and adverse impacts of each of the alternatives. We examine the impacts of current and proposed administrative or general operations, habitat management, and visitor services/public uses on each of the physical, biological, and cultural resources noted above. Impacts on the Karner blue butterfly easement are under separate subheadings under each major resource area topic.

We end the chapter with discussions on:

- Cumulative impacts
- The relationship between short-term uses of the human environment and enhancement of long-term productivity
- Unavoidable adverse effects
- Potential irreversible and irretrievable commitments of resources, and
- Environmental justice.

We provide some context for evaluating impacts in table 4.1

**Table 4.1. Existing Context for Impacts Analysis at Great Bay Refuge and Karner Blue Butterfly Conservation Easement.**

Gulf of Maine Watershed	44.2 million acres (69,115 square miles)
New England/Mid-Atlantic Coast–Bird Conservation Region 30	24.4 million acres
New Hampshire Coastal Watersheds	525,000 acres
Great Bay Estuary	6,000 acres
Peverly Brook Watershed	907 acres
Length of Peverly Brook within Refuge	1.5 miles
Town of Newington*	5,214 acres
Great Bay Refuge	1,103 acres
Forest Habitat	659 acres
Grassland/Shrubland Habitat	195 acres
Forested Wetlands	149 acres
Impounded Waters	62 acres
Salt Marsh	36 acres
Rocky Shoreline	2 acres
Footprint of Existing Refuge Headquarters, Residence, and Parking Lot	0.6 acres
Footprint of Existing Maintenance Facility	0.03 acres
Length of Trail Network	2.5 miles
Footprint of Remaining Military Infrastructure in Weapons Storage Area (Road, Buildings, and Parking)	7 acres
Refuge Road (Paved and Gravel) Network	7.9 miles
Karner Blue Butterfly Conservation Easement	29 acres
Additional Area Managed by New Hampshire Fish and Game for Karner Blue Butterflies	350 acres
City of Concord*	43,136 acres

*\*The Great Bay Refuge is in the town of Newington and the Karner blue butterfly conservation easement is in the city of Concord.*

## Regional Scale Impacts

### Air Quality Impacts

#### Impacts on Air Quality that Would not vary by Alternative

Regional air quality should not be adversely affected by refuge management activities regardless of which alternative is selected. There are no major stationary or mobile sources of air pollutants at the refuge. None of the alternatives would violate EPA standards and all three would comply with the Clean Air Act. Since most of the impacts to regional air quality originate from sources off the refuge, management actions on the refuge would have negligible effect on regional air quality.

In our opinion, all management alternatives would help reduce adverse impacts on air quality by

- maintaining natural vegetative cover on the refuge's 1,103 acres;
- requiring that all new facilities and upgrades to existing facilities be energy efficient; and,
- limiting public uses to those that are appropriate, compatible, and wildlife-oriented activities.

Collectively, these management actions would help reduce the potential for additional sources of emissions in the surrounding landscape.

We do not expect refuge visitors traveling in motor vehicles to add measurably to the current level of emissions, as described under each alternative below based on projected visitation numbers. Except for the paved entrance road and parking lot, public access on the refuge is limited to non-motorized pedestrian traffic only.

The following management actions have the greatest potential to adversely affect air quality:

- Prescribed fire
- Mowing and cutting of vegetation
- Trail maintenance
- Demolition of buildings
- Removal of impoundment infrastructure
- Restoration of these sites

The degree to which we would implement these activities varies by alternative.

#### *Karner Blue Butterfly Conservation Easement*

There are no buildings on, and no motorized vehicle visitor access to, the 29-acre Karner blue butterfly easement. We are not proposing any new construction or access that would cause air quality impacts under any of the alternatives. On average, 1 to 2 acres of the easement are burned annually using prescribed fire. NHFG also burns an additional 60 to 70 acres annually of nearby land owned by the city of Concord. The acreage burned on the Karner blue butterfly easement would be the same under all three alternatives. The refuge follows a prescribed fire burn plan to minimize smoke impacts on the neighboring Concord airport and to address other air quality issues during the burn. We anticipate no differences in impacts to air quality among the three alternatives since the proposed management prescriptions are the same.

#### **Impacts on Air Quality Under Alternative A**

##### *Benefits*

Alternative A would include few new ground-disturbing activities and would introduce few additional emission sources. The refuge would remain open to pedestrian traffic only, except for the paved entrance road and parking area, thus minimizing emissions from motorized vehicles. We would continue to use energy efficient practices and adopt additional practices, as feasible, including the use of energy efficient vehicles and lighting. There would be continuing benefits to air quality from maintaining native vegetation on the refuge, including 659



acres of upland forest. Trees serve as long-term carbon “sinks” reducing the amount of atmospheric carbon dioxide which contributes to global climate change (USEPA 2010).

#### *Adverse Impacts*

The refuge currently receives approximately 30,000 visitors annually and we do not expect visitation to increase to the point that its impacts on air quality become problematic. We expect very short-term, negligible localized effects on air quality by emissions from

- motor vehicles used by refuge staff;
- refuge equipment;
- annual prescribed burns of grassland habitat on up to 60 acres of the refuge and 1 to 2 acres of the Karner blue butterfly easement;
- mowing and cutting of grasslands (up to 169 acres) and shrubland habitat (up to 26 acres);
- removal of buildings and paved surfaces in the Weapons Storage Area; and,
- management of 62 acres of impounded wetlands.

However, no foreseeable long-term or cumulative impacts on air quality would result from any current refuge activities, nor would these activities contribute to any substantial increase in ozone levels, particulate matter, or other negative air quality parameters.

The major pollutants from prescribed burning are particulates and gases. Particulates—consisting of small particles of ash, partly consumed fuel, and liquid droplets—can reduce visibility or cause negative effects on the health of people with respiratory illnesses. The gases released by prescribed burns include carbon monoxide, carbon dioxide, hydrocarbons, and small quantities of nitrogen oxides. However, low intensity prescribed burning, such as the current program on the refuge, releases inconsequential amounts of these gases (USDA 1989). We would follow prescribed burn plans at both the refuge and the easement, which consider smoke management and other environmental and geographical factors, to minimize impacts on surrounding areas, including the adjacent airports. Based on our experience, we expect the level of prescribed burning we are propose under alternative A to produce no major, long-term adverse air quality impacts.

The ongoing removal of structures and roads in the former Weapons Storage Area may contribute localized and negligible short-term effects from dust and exhaust from vehicles and heavy equipment. To mitigate for this, we would follow dust abatement practices and minimize exposure of bare soil through establishing native vegetation as quickly as possible.

#### **Impacts on Air Quality Under Alternative B**

##### *Benefits*

The beneficial effects on air quality under alternative B would be similar to those under alternative A. There would be no substantive change in air quality, no violation of air quality standards under the Clean Air Act, and no cumulative effects on ozone and particulate matter. Having refuge staff stationed onsite would reduce emissions from the approximately 30-mile commute between

the Refuge Complex headquarters at Parker River Refuge and Great Bay Refuge. However, this would be offset by more vehicle use by refuge staff to conduct increased monitoring and management. The construction of a new low emissions Leadership in Energy and Environmental Design (LEEDS)-certified headquarters/visitor contact station and maintenance facility would provide long-term air quality benefits under alternative B, through the use of energy efficient materials and green technology. For example, we would consider water conservation measures and alternative energy sources and implement these practices to the extent practicable.

#### *Adverse Impacts*

We anticipate some short-term adverse impacts during the construction phase of the new headquarters/visitor contact station and maintenance facility. We would minimize dust during construction of the facilities through practices such as the following:

- Use, where possible, water and approved chemicals for dust control.
- Install and use hoods, fans, and fabric filters to enclose and vent the handling of dusty materials,
- Cover open equipment for conveying materials.
- Remove spilled or tracked dirt promptly and remove dried sediments resulting from soil erosion.

As the new building would be larger than the existing refuge office, its operation would require greater energy use. We would offset this increase in energy usage over the long term through energy efficient construction and design and other conservation measures.

We anticipate negligible increases in regional vehicle emissions from a projected 10 percent increase in visitation, as much of the refuge would remain closed to motorized vehicles. We also expect minimal windborne dust resulting from management vehicles traveling on refuge gravel roads.

Similar to alternative A, we anticipate negligible adverse effects from our grassland and shrubland habitat management activities. Under alternative B, we would manage 152 acres of grassland and shrubland through a combination of mowing, brushhogging, and prescribed burning. We would use prescribed fire on up to 60 of these 152 acres annually. Each of these management techniques would contribute negligibly to regional emissions. As under alternative A, we would follow burn plans which consider smoke management and other environmental and geographical factors, to minimize impacts on surrounding areas, including the adjacent airports.

We expect a short-term increase in windborne dust and other particles during

- the removal of impervious surface on refuge roads;
- demolition of remaining buildings in the former Weapons Storage Area;
- removal of structures at Fabyan Point, removal of the Lower Peverly Pond Dam infrastructure; and
- restoration of these sites.



## Impacts on Air Quality Under Alternative C

### *Benefits*

Similar to alternative B, we would continue energy efficiency practices and would realize similar long-term benefits from a new LEEDS-certified energy efficient headquarters/visitor contact station and maintenance facility. We expect that long-term carbon sequestration would be modestly higher with the increase in forest cover to 852 acres. We anticipate slight improvements to air quality under alternative C with the cessation of all management of grasslands and shrublands and a reduction in management actions overall. This would eliminate any emissions associated with prescribed fires and the equipment used for mowing. Small wildfires that do not threaten public health, safety, or operations of the adjacent airfield may be allowed to burn under this alternative. However, we would expect that this would happen very infrequently (approximately 50 to 70 year intervals). The removal of all impoundment infrastructures and restoration of Peverly Brook to stream habitat would reduce the amount of refuge vehicle traffic that is currently associated with management of the three impoundments. This would also allow for closure of some refuge management roads, leading to a long-term decrease in windborne dust due to vehicles.

### *Adverse Impacts*

We anticipate a 10 to 12 percent increase in visitation due to an increased emphasis on interpretive programs, a modest increase in trail length, and expanded access to the refuge. This would cause a slight increase in vehicle emissions from visitors arriving to the refuge by car.

Similar to alternative B, there would be a slight short-term increase in windborne dust and other particles from the demolition of the remaining buildings in the former Weapons Storage Area, removal of all impoundment infrastructure and associated access roads, and the restoration of these sites. This would be offset by the long-term benefits of restoring these sites to natural conditions and by relying on passive management by natural disturbances, rather than active management requiring motorized equipment.

## Hydrologic Systems and Water Quality Impacts

## Impacts on Hydrologic Systems and Water Quality that would not vary by Alternative

### *Benefits*

We would continue to partner with several ecological research and management organizations that are focused on improving the health of the Great Bay Estuary and its watershed. These include GBNERR, GBRPP, NHFG, NHDES, PREP, TNC, and UNH. Although the estuarine system is relatively intact and remarkably resilient, it has been significantly altered and degraded. PREP has documented several negative and cautionary environmental trends in Great Bay (chapter 2, table 2.1).

Under all alternatives, Great Bay Refuge would continue to partner with local, State, and Federal agencies to help restore and maintain the water quality of the Great Bay Estuary. We would continue to remove unnecessary buildings and other infrastructure, such as in the former Weapons Storage Area, amounting to approximately 7 acres, and rehabilitate contaminated sites to improve hydrology, water quality, and groundwater recharge.

### *Adverse Impacts*

We expect that none of our proposed refuge management activities would adversely affect regional water quality. Each alternative would comply with the Clean Water Act and no activities would violate Federal or State standards for contributing pollutants to water sources.

We do not expect that visitation would increase enough under any alternative to have an adverse impact on water quality.

All the alternatives include some level of invasive plant control using mechanical, chemical, and biological control methods. The use of herbicide has the potential to impact water quality; however, the refuge would only use chemical controls as a last option if the other techniques are not effective. We would only use herbicides approved by the regional contaminants coordinator and only in accordance with approved rate and timing of application.

Oil spills and release of other contaminants from refuge activities are also a possibility within the Great Bay estuarine system. However, we closely monitor and mitigate all of our routine activities that have some potential to result in chemical contamination of water directly through leaks or spills or indirectly from soil runoff. Potential sources include motorized watercraft, control of insects and weeds around structures, use of chemicals for de-icing roads and walkways, and the use of soaps and detergents for cleaning vehicles and equipment. Refuge staff would continue to participate in oil spill response training and coordination to prevent and prepare for possible leaks or spills. The adjacent Tradeport and associated airfield (including the new de-icing pads) continue to pose potential risks to water quality. The refuge would continue to communicate with Tradeport personnel about potential runoff and water quality issues. We would also continue to take the following precautions to minimize the potential for chemicals and petroleum products to be introduced into aquatic systems:

- Ensuring all staff are up-to-date on the spill prevention plan
- Obtaining advanced training in spill prevention and spill response
- Pouring or mixing chemicals or petroleum products will be conducted no closer than 25 feet from surface water

While some potential risk exists from the existing or increased visitor activities we are predicting under all alternatives, we believe these would be negligible when managed properly. We recognize that visitor activities near wetlands may directly impact water quality and aquatic species over the long term, especially if people wander off-trail. However, we conduct outreach and enforcement in visitor areas to minimize this potential, although our capabilities vary by alternative. Potential adverse affects to wetlands could also occur if visitor facilities are improperly placed in wetland habitats, or if erosion is allowed to occur unchecked during maintenance or construction. We try to minimize those effects in a variety of ways. Our refuge parking lot is located away from streams, rivers, or other wetlands. Refuge staff and volunteers monitor roads and trails for damage and remediate any problems encountered. We would also be vigilant during maintenance and construction activities to watch for resource damage and will stop activities as soon as they are observed. Where ever there is the potential for runoff we use silt fences or other best management practices to avoid impacts.

#### *Karner Blue Butterfly Conservation Easement*

The easement is predominantly an upland site, with only one small stream. Our proposed management activities do not differ between the alternatives. We plan to use prescribed fire on 1 to 2 acres annually and may occasionally require the use of herbicides to control invasive species. As noted above, we would only use those herbicides approved by the Regional Contaminants Coordinator and only in accordance with approved rate and timing of application. We anticipate that these management activities would not impact water quality or hydrology given the easement's relatively flat topography.

### **Impacts on Hydrologic Systems and Water Quality Under Alternative A** *Benefits*

Under alternative A, the major water quality and hydrological benefits would be maintaining mostly natural cover on the 1,103 acre refuge and minimizing the amount of impervious surface. We would continue to remove buildings and other impervious surfaces on approximately 7 acres in the former Weapons Storage Area, resulting in a benefit to water quality and hydrologic systems due to the ability of soils and vegetation to filter out pollutants. We would also continue to work with GBNERR, GBRPP, and other partners to help restore and maintain water quality within the Great Bay Estuary. Under alternative A, we do not propose any new trails or roads and would continue to prohibit wheeled and motorized public access outside of the paved entrance road and parking lot.

### *Adverse Impacts*

Under current management, we would maintain the three impoundments on the 1.5 mile Peverly Brook, thereby providing limited ability to restore hydrologic function and improve water quality within the Peverly Brook system. Erosion continues to undermine the integrity of the Lower Peverly Pond Dam. Given its deteriorating condition, we would potentially have a greater adverse impact on water quality under alternative A, as compared to alternatives B and C, if the structure abruptly fails and a flush of sediment results at a time of year when aquatic biota downstream are vulnerable. We would continue to minimally maintain the infrastructure to ensure that it does not create a safety hazard; however, no portion of the Peverly Brook drainage is slated for restoration in current management. With the current lack of staff at Great Bay, we would have limited ability to inventory and control of invasive aquatic plants including brittle waternymph. We would likewise have limited ability to routinely monitor sediments and water within the impoundments for contaminants and to implement any remediation or restoration of water resources. The Air Force will continue its long-term monitoring of groundwater wells, which occurs four times per year, and is scheduled to occur for at least the next 50 years.

### **Impacts on Hydrologic Systems and Water Quality Under Alternative B** *Benefits*

Under alternative B we propose a greater role for the refuge in conserving ecologically significant lands around Great Bay in partnership with the GBRPP. This would provide greater long-term protection for Great Bay Estuary's water quality by maintaining these lands in natural cover and preventing increases in impervious surfaces. Vegetated buffers along shorelines have been shown to reduce drastically the sediments, nutrients, and other pollutants entering waterways, especially when near agricultural fields and developed areas (Klapproth and Johnson 2000). We would work with the GBNERR, UNH, and others to improve and maintain water quality in the Great Bay Estuary through restoration of oyster reefs and eelgrass beds in intertidal waters off the refuge. Both oyster reefs and eelgrass beds help improve water quality and water clarity by filtering pollutants from water (Short et al. 1992a). Some of the most significant reefs and beds are found just offshore of the refuge in Herods Cove, around Nannie Island, and off Woodman Point.

In addition to other planned ongoing restoration activities identified above with regards to Weapons Storage Area facilities, under alternative B, converting the paved road past the Service residence (e.g., toward the Margeson Estate) to gravel or other more permeable surface would also result in improved water quality and groundwater recharge by reducing imperviousness and increasing infiltration.

The proposal to remove the Lower Peverly Dam and associated infrastructure is one of the actions proposed under alternative B with the greatest potential to affect water quality. This dam impounds approximately 7 acres of water. The

objective would be to restore a 1,100 foot section of Peverly Brook to stream habitat. This would improve hydrologic function over the long term along this central portion of the 1.5-mile brook. The restoration would contribute to improved water quality by removing the existing deteriorating infrastructure that is causing erosion and sedimentation and by the removal and control of invasive plants that currently grow in Lower Peverly Pond. We would try to minimize any concern about large amounts of sediment washing into Peverly Brook downstream during and after dam removal by installing silt fences, sediment traps, or otherwise following best management practices, as warranted. American Rivers, in their report on “The Ecology of Dam Removal” (American Rivers 2002), state that any short-term consequences associated with dam removal can be minimized through careful planning and timing of the removal process. We would plan to work with NHFG, NHDES, NEFO, the Service’s Central New England Fishery Office, and others to develop a detailed plan.



Greg Thompson/USFWS

Upper Peverly Pond

With onsite refuge staff, we would be able to work with partners to help conduct sediment and water quality monitoring in the Peverly Brook system. This would lead to improved water quality in the long term by alerting the refuge to potential threats to water quality (e.g., such as in case of runoff from nearby airfield) in a more timely, reliable, and consistent manner. It would also provide more detailed data on the need for remediation of contaminated sediments, where feasible.

#### *Adverse Impacts*

We would continue to maintain the Stubbs Pond impoundment to benefit waterfowl and waterbirds because of the regional significance of this freshwater wetland. Also, the level of sediment contamination in Upper Peverly Pond remains sufficiently high such that removal of that impoundment

at this time would cause potential adverse impacts to downstream water quality by releasing these sediments into the Peverly Brook system.

Some sediment would likely be released downstream from the proposed removal of Lower Peverly Pond Dam, but according to our records, those sediments are not contaminated (appendix I). As noted above, we would work with partners to design the dam removal project to minimize impacts. Hart et al. (2002) recommend that dam removals be designed after careful consideration of the expected magnitude, timing, and range of physical, chemical, and biological responses (Hart et al. 2002). Lenhart (2000) recommends that certain basic information should be obtained before proceeding with restoration and management. This information includes the following:

- Characterization or model of surface sediment deposit
- Depth of water-restraining layers
- Depth to water table and groundwater gradient
- Location of original stream channel
- Identification of reference sites to serve as models for restoration



There are few definitive studies on the impacts of small dam removal that relate directly to our proposed project. In the studies documented, it was difficult to draw general conclusions about the impacts on water quality resulting from such disturbances as increased sedimentation. The observed rates and patterns of sediment transport are quite variable after removing small dams, and depend on the amount and type of sediment, channel slope, and flow magnitude (Hart et al. 2002). Most projects documented a flux of sediment following dam removal, but in very small impoundments, or those with limited accumulation, sediments can be flushed out relatively rapidly (Stanley et al 2003). Assuming there are no toxic substances in the pond's sediments, some studies indicate that flushing of sediment from the pond area may speed recovery of the former pond area by providing more favorable conditions for native vegetation in the floodplain and fish in the stream (Lenhart 2000). The stability of the streambanks would be important to assess as well prior to dam removal. Erosion can be severe, depositing additional sediments into the stream and affecting water quality (Lenhart 2000). Streambank stabilization and grading may be necessary to prevent this. Our plan to work with partners to design the project with consideration of the risks noted above would minimize those effects on water quality.

Given that only one of the three dams would be removed under alternative B, hydrologic function would not be restored to the entire Peverly Brook drainage. However, the Service would develop a protocol for ongoing evaluation of Upper Peverly to determine if the pond should be maintained, dredged, or breached over the next 15 years. We would establish threshold or trigger levels that would inform management based on regional landscape context, contribution to Federal trust resource conservation, potential management implications and commitments, changes in visitor services, and long-term solutions to contaminant issues.



Greg Thompson/USFWS

*Ferry Way Trail*

Another concern with dam removal is that the potentially nutrient rich sediment in the former reservoir may represent prime habitat for quickly establishing invasive species (Stanley and Doyle 2003). We would minimize this by treating the site as warranted. Any potential risks to water quality from treatment of aquatic invasive plants would be mitigated by using only herbicides approved by the regional contaminants coordinator and only in accordance with approved rate and timing of application. In addition, we envision long-term benefits to hydrologic function through invasive plant removal. Other water quality impacts from dam removal would be minimized by adhering to a project design and an implementation plan developed in partnership with State and Federal agencies, and other experts. As recommended by Lenhart (2000), we predict our focus in the few years post dam removal would be on ensuring stream banks are stable, and controlling undesirable vegetation.

We anticipate a 10 percent increase in visitation from expanded interpretive programs and a modest expansion of the trail network. We would open a portion of the restored former Weapons Storage Area, linking it to the Ferry Way Trail. In addition, we would add another overlook of Great Bay off the Ferry Way Trail and also add an overlook on Fabyan Point, once access issues there are resolved. All of these trails would remain open to foot traffic only, minimizing potential water impacts associated with wheeled or motorized vehicles. Trail maintenance and up to 1 mile of new trail construction activities would increase the potential for sedimentation and turbidity in streams and wetlands if erosion occurs from exposed soils. Because these activities may occur in proximity to shorelines and wetlands, we would adhere to best management practices during

trail construction and for long-term trail stewardship. For example, proper site preparation and use of standard mitigation practices, such as silt fences, would be implemented and further limit any potential for impacts.

We do not predict any major water quality impacts from the construction of a new headquarters/visitor contact station and maintenance facility. In planning and designing our new facilities, we would consider the potential effects on water quality and hydrology. There is the potential to create runoff of sediments through increased soil disturbance and removal of ground cover. We would design silt-fences and sediment traps, as warranted, to prevent runoff.

### **Impacts on Hydrologic Systems and Water Quality Under Alternative C**

#### *Benefits*

Similar to alternative B, we would work more actively with partners to conserve ecologically significant lands around Great Bay and to restore and maintain oyster and eelgrass populations leading to improved water quality in the Great Bay Estuary.

Under alternative C, our emphasis would be on natural ecological processes. We would plan to remove all three impoundments –Upper Peverly Pond, Lower Peverly Pond, and Stubbs Pond. This alternative would offer the most complete restoration of hydrologic function in the Peverly Brook system. After the three dams are removed, the brook and associated riparian areas would be restored to native vegetation. We would rely on beaver and other aquatic organisms to continue to “modify” this drainage. The removal of those impoundments, as well as access roads and Weapons Storage Area infrastructure in the Peverly Brook system, would further restore hydrological flow and riparian vegetation, improve resiliency in the system, and result in improved water quality over the long term. We anticipate a reduced need for invasive plant control as edge habitat and disturbances would be minimal once the habitats revert to forests. Restoration of the Peverly Brook system should eliminate the invasive aquatic brittle water nymph, which prefers ponded open water.

#### *Adverse Impacts*

Compared to alternatives A and B, under alternative C there is greater potential for sediments and contaminants to enter Peverly Brook. Ultimately this could affect Herods Cove and the eelgrass and oyster beds in the Great Bay Estuary, because of the magnitude of soil disturbance associated with the removal of the three dams. Before removal, however, contaminated sediment and other water quality issues (such as invasive aquatic plants) would be remediated to the point that we do not feel it would jeopardize ecological and human health. We would work with State partners to establish acceptable thresholds which would need to be achieved prior to the dam removals. We anticipate short-term impacts to water quality during removal and restoration of the impoundments on Peverly Brook to be similar to those detailed under alternative B. These impacts would be offset by the long-term benefits to water quality and hydrologic function.

We would also continue to control invasive plant species. The use of herbicides would pose continued potential risks to water quality; however, we would use only herbicides approved by the regional contaminants coordinator and only at approved rates and timing.

In addition to the new trail segments proposed in alternative B, we would create a spur trail off the Upper Peverly Trail, paralleling Peverly Brook a short distance, then continuing along a refuge management road out to Woodman Point. Total trail construction would be less than 1 mile. We would use best management practices during trail construction and for long-term trail stewardship to minimize any potential impacts to water quality. Trails would



remain open to pedestrian traffic only. Any potential impacts to water quality from existing refuge management roads would be sharply reduced with the closure of many of these roads as we discontinue management of grasslands, shrublands, and impoundments. Roads to be closed include Nottingham Road, Lower Peverly, Stubbs Pond, and all roads in the former Weapons Storage Area.

## **Socioeconomic Resources Impacts**

### **Impacts on Socioeconomic Resources that Would not vary by Alternative**

National wildlife refuges provide economic value to local and regional economies in several ways. Direct infusion of funds into the local economy come from refuge purchases of goods and services, personal spending in the local community by refuge employees and visitors, and refuge revenue sharing payments. Refuges also provide nonmarket values (values for items not exchanged in established markets) such as maintaining species of conservation concern, preserving wetlands, educating future generations, providing enjoyment of natural habitats and wildlife for the public, and adding stability to the ecosystem (Carver and Caudill, 2007). Unfortunately, Great Bay Refuge has limited data on direct expenditures into the local economy, in part because the refuge was de-staffed in January 2008. We anticipate modest differences among the alternatives in terms of socioeconomic impacts based on estimates of refuge visitation. Regardless of which alternative we select, we would continue to pay refuge revenue sharing payments each year to the town of Newington. Numerous studies show that open space lands, such as refuges, contribute more in revenue than they require in expenditures (Auger 1996, American Farmland Trust 2010). In addition, conserved lands can stabilize or increase nearby or adjacent property values (Gies 2009). Therefore, maintaining Great Bay Refuge as conserved open space likely affords economic benefits to the surrounding community.

#### *Karner Blue Butterfly Conservation Easement*

The Service does not own the Karner blue butterfly easement in fee and therefore does not provide the city of Concord with refuge revenue sharing payments. In addition, there are no onsite staff and few visitors so there is minimal contribution to the regional economy through local expenditures. The permanent protection of this parcel may provide some of the same economic benefits as Great Bay Refuge to the surrounding community. However, due to the easement's small size and location, these benefits would be on a much reduced scale. Easement lands lie adjacent to an active airport, business park, and other industrial development, and are not in close proximity to residential areas.

### **Impacts on Socioeconomic Resources Under Alternative A**

#### *Benefits*

Given the lack of current staffing at the refuge, our contributions are negligible to the local economy in terms of refuge staff jobs, income, expenditures, and purchase of goods and services for refuge activities.

#### *Adverse Impacts*

No adverse impacts are anticipated.

#### *Karner Blue Butterfly Conservation Easement*

We do not envision any additional benefits or adverse impacts under alternative A that were not already addressed above under impacts that would not vary by alternative.

### **Impacts on Socioeconomic Resources Under Alternative B**

#### *Benefits*

Filling the four approved refuge staff positions would minimally increase benefits to the local economy in terms of jobs, income, and expenditures. We also anticipate an increase in the need for seasonal biological technicians and hiring local contractors to assist with building demolition, dam removal, and site restoration would provide additional income into the local economy.

Likewise, construction of a new refuge headquarters/visitor contact station and maintenance facility would provide short-term income to the local economy for labor, materials, and services.

The 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation reported that people spent \$560 million on wildlife-related recreation in New Hampshire in 2006 (USDOJ and US DOC 2006). We predict enhancing refuge visitor services programs, particularly refuge trails and interpretive programs, would increase visitation by approximately 10 percent from current numbers. This would also likely provide an associated increase in visitor expenditures in the local economy. Although the majority of visitors to the refuge participate in wildlife watching, hiking, and snowshoeing, a small percentage also participate in hunting. The proposed expansion of hunting under alternative B, may also contribute to the local economy. This increase, however, would remain negligible in the context of the economies of the surrounding communities. Under alternative B, we would anticipate up to 42 additional hunters visiting the refuge annually (30 hunters during the fall archery deer hunt, and 12 during the turkey hunt). The 2006 National Survey reports that an individual hunter in New Hampshire spends \$122 annually. These numbers are estimates and a more detailed hunt program description (including open areas, numbers of hunters, timing, etc.) would be forthcoming in a separate NEPA analysis and administrative process. Given our estimate of 42 additional hunters, the potential additional contribution to the local economy from the refuge's expanding the hunting program would be up to \$5,124.



Greg Thompson/USFWS

*Viewing wildlife on Ferry Way Trail*

#### *Adverse Impacts*

No adverse impacts are anticipated.

#### *Karner Blue Butterfly Conservation Easement*

Under alternative B, we would improve the existing self-guided interpretive trail and create a more informative kiosk. We anticipate a slight increase in visitation as a result of these improvements. We predict that visitors to the easement would have a higher quality outdoor experience and gain a greater appreciation of the habitat and its inhabitants. The creation of a pine barrens brochure and improved information on the refuge Web site would make the easement available to a wider audience. Expanded cooperative law enforcement between NHFG and the Service would further improve the quality of visitor experiences by enhancing safety and minimizing unauthorized uses that could damage the ecology of the site.

#### **Impacts on Socioeconomic Resources Under Alternative C**

##### *Benefits*

Under alternative C, we anticipate an increase in visitation by up to 12 percent a year given the increase in public programs and expanded trail access. This would lead to an associated increase in visitor expenditures in the local economy. There would also be a slight increase in short term contract work associated with the proposed restoration projects (impoundments, removing roads, etc.). Again, we anticipate that the expansion of hunting proposed under alternative C would also contribute a negligible amount of money to the local economy because of hunter-related expenditures. Under alternative C, we would anticipate up to 300 additional hunters visiting the refuge annually (up to 100 hunters during

the fall archery deer hunt, up to 200 during turkey hunt(s) [up to 100 in a spring turkey hunt and up to 100 in a fall hunt]). As mentioned under alternative B, the 2006 National Survey reports that an individual hunter in New Hampshire spends \$122 annually. Based on our estimate of 300 additional hunters, the potential contribution to the local economy from the refuge's expanded hunt would be \$36,600. Again, more detailed description of the hunt program would be forthcoming, along with a separate NEPA analysis.

*Adverse Impacts*

No adverse impacts are anticipated.

*Karner Blue Butterfly Conservation Easement*

The impacts under alternative C would be the same as those under alternative B.

## Refuge-specific Impacts

### Soils Impacts

#### **Impacts on Soils that Would not vary by Alternative**

Soil is composed of small particles of chemically weathered rock, decaying organic matter, gases, water, and living organisms. The soil layer is one of the most active sites of energy exchange, and it plays a critical role in ecosystem processes such as the carbon, nitrogen, and oxygen cycles. Healthy soils are critical to nutrient cycling and plant productivity on the refuge and must be protected to sustain the variety of wetland, riparian, and upland habitats. Conversion from natural land cover to a developed use with impervious surfaces is predicted to have the most severe impacts to soils. Under all alternatives, we would strive for the greatest amount of natural cover and the least amount of impervious surface.

Less intense uses, such as hiking, can also degrade soil qualities. Trails and roads by design are typically barren and compacted, so some loss of productivity is expected with such infrastructure. All wheeled vehicles, motorized or otherwise, which have the potential to cause severe erosion and rutting, are not allowed on the refuge. Camping and fires are also not allowed on the refuge. Regardless of which alternative is selected, we would continue to use best management practices in all management activities to maintain the health and productivity of refuge soils and to minimize erosion, compaction, and other impacts.

Overall, Great Bay Refuge's soils are productive and in relatively good condition. The refuge is also relatively flat, which reduces the risk of soil erosion. However, some erosion and contaminated sediments are associated with the Peverly Brook system. This is likely the result of past land uses, particularly the former Air Force Base. Our proposed actions to restore the productivity and integrity of these soils vary by alternative.

All of the alternatives propose using integrated pest management (IPM) to control invasive species. The IPM approach combines mechanical, manual, biological, and chemical controls. Mechanical and chemical controls have the greatest potential to affect soils. Mechanical methods that disturb the soil, such as hand pulling or digging, would only be used if we determine that soil disturbance would be minimal and the potential for recolonization by invasive species is low. The advantage of chemical controls is that they are often the most effective, particularly when treating large areas or an established site. The disadvantages are that the chemicals may affect non-target species at the site and may contaminate soils and surface or groundwater. We would take all appropriate

steps when applying herbicide including use of minimum effective dosage, using application methods that minimize non-target effects, applying during optimal growth stage for effectiveness, and adhering to licensing requirements and other regulations. Again, we would only use herbicides approved by the regional contaminants coordinator and only in accordance with approved rate and timing of application.

Prescribed fires help reduce fuel loads and thereby prevent excessively hot fires that could damage soils. Also, prescribed fires provide benefits by releasing nutrients stored in plant materials back into the soil, off-setting any short-term adverse impacts to the soils immediately following a burn. Soil damage from fires, or from erosion on fire-damaged sites, is unlikely to occur on the refuge because of the rarity of wild fires and due to the relatively flat topography of the area.

#### *Karner Blue Butterfly Conservation Easement*

Similar to Great Bay Refuge, prescribed fires at the Karner blue butterfly easement would reduce fuel loads and prevent excessively hot fires that could damage soils. The easement is within the pine barrens ecosystem, which is a fire-dependent system. Therefore, fire is a necessary and beneficial disturbance. However, given the small size and proximity to development of the easement, all wildfires on it would be suppressed to avoid risk to adjacent properties. We would develop a prescribed burn plan that would minimize any other potential adverse impacts to soils. No new trails are proposed that would further compact soils or cause erosion.

### **Impacts on Soils Under Alternative A**

#### *Benefits*

The greatest benefit to soils under alternative A would be the ongoing work of GBRPP, which the refuge is a member of, to conserve additional ecologically significant lands around Great Bay, thus maintaining more lands in natural cover and controlling the amount of impervious surfaces which degrades soil properties. Alternative A includes no expansion of the trail network that would cause additional soil compaction. The ongoing removal of existing infrastructure and impervious surface in the former Weapons Storage Area would provide some modest benefits to soils.

#### *Adverse Impacts*

Alternative A offers limited ability to address existing sediment contamination in the Peverly Brook system, particularly in Upper Peverly Pond. The lack of staffing provides insufficient capability for sampling and remediation of poor soil and water quality conditions. In addition, the existing Lower Peverly Pond impoundment infrastructure is failing, eroding, causing downstream sedimentation, and other adverse impacts to soils. There are no plans for removal and restoration or stabilization of this failing structure under current management. Alternative A would maintain the existing management road network and proposes a much slower pace for removing buildings in the former Weapons Storage Area and elsewhere, as well as for restoring the soils and natural vegetation to these sites.

The use of prescribed fire and mowing to maintain grasslands and shrublands would have the potential to cause some soil compaction through use of heavy equipment.

#### *Karner Blue Butterfly Conservation Easement*

We do not envision any additional benefits or adverse impacts under alternative A that were not already addressed above under impacts that would not vary by alternative.

## **Impacts on Soils Under Alternative B**

### *Benefits*

The removal of the Lower Peverly Pond impoundment infrastructure and its restoration to stream habitat would improve soil conditions by eliminating the existing soil erosion and sedimentation input occurring in the vicinity of the deteriorating dike. We anticipate a greater ability to address existing and potential sediment contamination in the Peverly Brook system through monitoring and remediation, where feasible, and greater ability to manage remaining infrastructure to prevent erosion, the creation of gullies, and other adverse soil impacts.

Conversion of paved road to gravel, or other more permeable surface, in the stretch past the residence (toward the Margeson Estate) and removal and restoration on approximately 7 acres of unnecessary buildings in the former Weapons Storage Area and at Fabyan Point would benefit long-term soil conditions.

### *Adverse Impacts*

Soil displacement and loss would result from construction of the proposed new headquarters/visitor contact station and maintenance facility and from removing unnecessary buildings and restoring those sites to native vegetation. Soil impacts resulting from building construction and/or removal would be partially offset by locating the new buildings in an area that is already disturbed as part of the former Weapons Storage Area footprint. Site selection for the building would include consideration of subsurface water, geology, water quality and quantity, and compatible soils, along with other necessary surveys to assure proper location of the facility and to minimize the impacts to refuge resources. Best management practices would be used to minimize impacts to soils from new construction and/or building removal, but there may be localized compaction and some erosion losses while work is being done on the site. While some permanent loss of soil productivity would occur, seeding with native grasses and other protective native vegetation would be used to return open areas of the site to a vegetated status as soon as practicable to protect soils. We would obtain all required Federal, State, and local permits applicable for constructing and/or removing buildings on refuge lands before activities begin.

The design of new and improved trails and associated infrastructure (e.g., information kiosks) to enhance visitor experiences and other infrastructure would include consideration of the potential to effect soils. The projected 10 percent increase in annual visitation (resulting in approximately 33,000 visitors total per year) might result in increased trampling and soil compaction along trails and around visitor facilities. Some compaction may also result from construction. We would also increase monitoring of intensive public use areas, reducing the potential for long-term impacts from unauthorized access. In addition, outreach, education, and enforcement on site would increase once proposed new staff is in place.

The expansion of the deer hunting season in the fall and the addition of a turkey season could also lead to a small increase in soil compaction in off-trail areas frequented by hunters. This is partially off-set by the nature of hunting, which is typically dispersed; and often hunters are either in a treestand or moving somewhat randomly through upland areas. Additionally, only a small number of visitors to the refuge would be engaged in hunting (hunters account for fewer than 90 visits to the refuge annually; 0.3 percent of an estimated visitation of 33,000), so we predict the amount of off-trail soil compaction would be negligible.

In our discussion under water quality, under alternative B we describe some soils impacts associated with the proposed removal of Lower Peverly Pond Dam. One



primary soils concern would materialize if stream banks become unstable once the dam is removed and a higher intensity flow is more established. However, we would prioritize establishing native riparian vegetation, and grading of banks as warranted, to minimize this concern.

Similar to alternative A, the use of prescribed fire and mowing to maintain grasslands and shrublands has the potential to cause some soil compaction through use of heavy equipment. However, annual burn plans and management prescriptions would be designed to ensure risk is negligible.

#### *Karner Blue Butterfly Conservation Easement*

In addition to the impacts outline under alternative A, the construction of a proposed kiosk at the east end of the interpretive trail would cause short-term, localized minor soil disturbance on less than 100 square feet in an area already impacted (adjacent to trail and parking area). This would also be off-set by the enhanced visitor interpretation provided on the kiosk, raising awareness about the ecology of the Karner blue butterfly and pine barrens habitat.

NHFG, who coordinates management on the easement, is shifting from planting lupine seedlings to seeding lupine. Sowing seeds would reduce the overall amount of soil disturbance compared to that required when planting seedlings. This would reduce impacts to soil condition and minimize disturbances to cultural resources.

### **Impacts on Soils Under Alternative C**

#### *Benefits*

Under alternative C, the long-term benefits to soils would exceed those of alternatives A and B. We would remove all three impoundments and restore those areas to stream habitat and native vegetation. We would also eliminate grassland and shrubland management. Additionally, we would remove all remaining structures and unnecessary management access roads, and then restore these sites to natural conditions. In the long term, restoring native habitats and natural communities throughout the refuge would help restore and maintain soil health.

#### *Adverse Impacts*

Similar to alternative B, soil displacement and loss would result from the construction of the proposed new headquarters/visitor contact station and maintenance facility. We would partially offset impacts to soils by locating the building in an already disturbed area.

As in alternative B, there would still be some localized increase in soil impacts where public access and use occurs. The existing 2.5-mile trail network would be expanded to include up to an additional 1 mile of trail. All trails would remain open to pedestrian traffic only, thus minimizing potential impacts from wheeled or motorized vehicles. We would design our outreach, education, and monitoring programs to reduce risk to soils from the proposed new trails, of which only about 0.2 miles would not use existing roads. In addition, we would close and restore several miles of existing refuge management roads. We anticipate the potential for soil compaction to be slightly higher under alternative C from the proposed expansions to the hunting program and opening more areas of the refuge to hunters. However, we anticipate the number of hunters annually visiting the refuge would still remain a relatively small proportion (less than 1 percent) of overall visitation.

#### *Karner Blue Butterfly Conservation Easement*

Same as alternative B.



## Vegetation Impacts

### Impacts on Vegetation that Would not vary by Alternative

#### *Benefits*

Under all the alternatives, we would continue to map, monitor, prioritize, and control invasive plant species across all habitat types. This would benefit all native vegetation. Alternatives B and C would realize greater invasive plant control given increased staffing of the refuge. Managing the deer population through a fall deer hunt offers benefits to vegetation, as heavy deer browsing can suppress natural regeneration and promote invasive plants. We would also continue to work with NHFG to control the nonnative mute swan, which are known to negatively impact native wetland plants important to waterfowl. We would continue to prohibit collecting of any vegetation by the public on the refuge, ensuring protection of all native plant materials.

Given the history of land use prior to the establishment of Great Bay Refuge, our management activities have helped previously disturbed areas recover. By maintaining most of the refuge in natural cover, we are able to maintain native vegetation through a combination of active and passive management. Vegetation in the forested wetlands and much of the upland forest is passively managed by natural processes.

#### *Adverse Impacts*

Refuge administrative activities and public uses on the refuge create some localized adverse impacts to vegetation. The presence of the trails and public visitation can introduce invasive plants to adjacent habitat, by up to 330 feet. Restricting public access on the trail network to foot traffic only helps limit potential adverse impacts to surrounding vegetation that might result from allowing bicycles or motorized vehicles. In addition, the boardwalk on the Upper Peverly Trail, refuge signs, and refuge outreach and education programs, require visitors to stay on the trail to minimize disturbance to wildlife and surrounding vegetation.

Some refuge management and restoration projects, including invasive species control, would have short-term negative impacts on vegetation, such as removal of plants, herbicide use, trampling and other damage to the plants structure. These would be off-set by providing long-term benefits to the diversity and health of the refuge's native plant communities.

#### *Karner Blue Butterfly Conservation Easement*

The goal of our vegetation management at the easement is to restore and maintain pine barrens habitat that supports wild lupine, the plant required by Karner blue butterfly larvae. We would accomplish this, in partnership with NHFG and others, by planting lupine and using prescribed fire and mechanical tools to maintain pine barrens conditions. Our use of prescribed fire is designed to mimic natural fire disturbances since pine barrens is a fire-dependent habitat type. These tools would create short-term negative impacts to vegetation, but provide long-term benefits to the diversity and health of the refuge's native plant communities. We would control invasive plants using a range of chemical, biological, and mechanical methods to further benefit native vegetation.

### Impacts on Vegetation Under Alternative A

#### *Benefits*

Limited public access to the refuge provides overall benefits to vegetation. Salt marsh vegetation would also continue to benefit from invasive plant monitoring and control. Grassland and shrubland vegetation would continue to be actively managed through use of prescribed burning, mowing, or cutting. The ongoing removal of buildings and impervious surfaces in the former Weapons Storage Area would greatly increase the amount of grassland in that unit. The abundance



Greg Thompson/USFWS

*Beaver pond on the refuge*

and distribution of wetland vegetation varies from year-to-year based on our adaptive management strategies to control the ratio of open water to emergent vegetation and to control invasive aquatic plants.

#### *Adverse Impacts*

Given the lack of staff at the refuge under alternative A, we would not be able to implement our biological objectives as effectively as under alternatives B and C. We would not be able to expand our invasive plant control program.

### **Impacts on Vegetation Under Alternative B**

#### *Benefits*

Benefits to salt marsh vegetation would be slightly higher than under alternative A due to greater visitor education about sensitivity of salt marsh communities, enhanced monitoring of sea level rise, and establishing baseline conditions of salt marsh health. Under alternative B, the amount of grassland habitat would decrease, while the amount of shrubland and forest would increase. The increase in the shrubland and forest habitat is based on the proposal to allow small (less than 3 acres) isolated patches of grassland and shrubland habitat to naturally revert to mature forest, which is expected to take at least 50 years. Over the next 15 years, however, we anticipate that the grassland patches would only succeed to a shrubland-type and existing shrubland would only succeed to a sapling-pole stand (2 to 12 inches diameter at breast height).

Similar to alternative A, the abundance and distribution of wetland vegetation would vary from year-to-year based on our adaptive management strategies to control the ratio of open water to emergent vegetation (approximately 50 percent of each) and to control invasive aquatic plants. With the refuge staff under alternative B, we anticipate greater monitoring of vegetation responses to our management actions, providing better data to guide our management decisions. Riparian vegetation would be restored along a 1,100 foot section of Peverly Brook, once the Lower Peverly Pond Dam is removed. We would also monitor the pine plantations to determine if they are reverting to natural forest community types

on their own, and implement management strategies as needed. We would restore approximately 30 acres of buildings, roads, and fencing associated with the former Weapons Storage Area to native grassland or shrubland.

#### *Adverse Impacts*

The modest expansion of the trail network (less than 1 mile), and the proposed expansion of the hunting program, would potentially have negligible adverse impacts on vegetation. Minimal vegetation loss would also result from construction of the proposed new headquarters/visitor contact station and maintenance facility since the buildings are located in the existing disturbed and hardened former Weapons Storage Area. The footprint of the new refuge facilities, including parking, would amount to approximately 1.1 acre. Similar to the discussion under soil impacts, the proposed trail and hunting expansions would potentially result in a negligible increase in the trampling of vegetation throughout the refuge. The opportunity for hunters and other visitors to serve as vectors for invasive plant seeds or other propagules would also be greater under alternative B, compared to alternative A. According to NHFG, the deer population along the New Hampshire coast is high and there is the potential for deer to over-browse native vegetation. Reducing the deer population would alleviate this potential for overbrowsing.

### **Impacts on Vegetation Under Alternative C**

#### *Benefits*

Alternative C restores more refuge area to native habitats than alternatives A and B. In addition to the strategies in alternatives A and B, under alternative C, we would restore estuarine habitats, including salt marsh, to Stubbs Pond once the impoundment infrastructure is removed. Approximately 44 acres of tidal salt marsh would be targeted for restoration. Native riparian vegetation would be restored to the entire 1.5 mile Peverly Brook drainage once all the impoundments are removed.

Forest vegetation would benefit the most under this alternative as areas of grass and shrub are allowed to succeed naturally to forest over time. The increase in the shrubland and forest habitat is based on the proposal to allow all of the refuge's grassland and shrubland habitat to naturally revert to mature forest, which is expected to take at least 50 years. Over the next 15 years, however, we anticipate that the grassland patches would only succeed to a shrubland-type and existing shrubland would only succeed to a sapling-pole stand (2 to 12 inches diameter at breast height). The emphasis would be on maintaining native forest types based on site capabilities, which includes considering soil type and water availability. With the reduction in access roads and edge habitat, we would expect a significant reduction in the introduction of invasive plants that are transported by equipment, vehicles, and people. The reduced need for invasive plant control would also minimize the short-term adverse effects of intensive invasive plant management. Establishing native forest and salt marsh vegetation allows the ecosystem to be more resilient to threats from climate change, pests, and pathogens.

#### *Adverse Impacts*

Under alternative C, we would discontinue our management of shrublands and grasslands, and allow these habitats to naturally succeed to forest thereby reducing vegetative diversity on the refuge. The only shrubland and grassland habitat on the refuge would be patches created and maintained by natural disturbances.

The expanded public use trails and hunting seasons under alternative C would cause greater impacts to vegetation, such as visitors and hunters trampling vegetation adjacent to and off-trails and serving as vectors for invasive plant

species. We predict these impacts would be negligible due to the relatively small number of hunters on the refuge and the fact that the majority of people stay on designated trail based on our observations. The new trail sections (less than 1 mile) are in areas already disturbed and would require minimal manipulation of native vegetation.

## Migratory Bird Impacts

### Impacts on Migratory Birds that Would not vary by Alternative

#### *Benefits*

There are no federally listed bird species on the refuge. However, there are many bird species of conservation concern as identified in various State and regional plans that occur on the refuge. The complete list is included as Appendix A, “Species and Habitats of Concern at Great Bay National Wildlife Refuge.” The Service is committed to protecting and managing for migratory birds under all the alternatives; however, the benefits to landbirds, waterfowl, waterbirds, and shorebirds vary under each alternative based on the proportion of different habitat types and the management strategies employed to maintain those habitats.

Under all alternatives, we would protect the refuge’s 2 acres of rocky shoreline habitat by limiting public access. Woodman Point, overlooking a portion of the shoreline, is an important roost site for bald eagles wintering on Great Bay. We would continue to monitor the wintering and potential nesting bald eagle population on and around the refuge. The new active nest site on Fabyan Point, in a closed area, would also be monitored and protected from disturbance. In addition, we would evaluate the importance of Nannie Island and surrounding waters to migratory birds and other Service trust resources to determine if the island should remain closed to public access or open for recreation or education purposes.

Under all the alternatives, we would continue to monitor and control invasive plant species such as purple loosestrife, *Phragmites*, brittle waterlily, autumn olive, nonnative honeysuckles, glossy buckthorn, among others. Controlling nonnative plants and allowing native plants to thrive, regardless of habitat type, would improve the quality of food resources and cover for all migratory birds. A growing body of research has indicated negative impacts to migratory birds from replacement of native plants by invasive species, including increased predation (Schmidt and Whelan 1999), reduced insect populations (Conover et al. 2010), and lower quality berries.

#### *Adverse Impacts*

We expect some disturbance to breeding and migrating birds from trail maintenance, herbicides and other invasive plant control methods, prescribed fire, mowing, and other management activities. Most adverse impacts are expected to be indirect and short-term, such as temporary reduction of cover and food resources. These impacts would be mainly limited to shrub habitats, as grassland plant community would recover within a growing season and invasive treatment in forested habitats would be targeted to understory species only. As discussed in the soil and water quality sections, the types of chemicals used on the refuge are expected to have a minimal effect on fish and wildlife species. We would apply herbicides only if other methods are shown to be ineffective. Only herbicides approved by the regional contaminants coordinator would be used, and only in accordance with approved rate and timing of application. We would apply herbicides using best management practices.

Some disturbance to breeding birds is likely from public use of the refuge. However, access would continue to be confined to only 2.5 miles of trails. The most sensitive nesting areas, including grasslands, salt marsh, and Stubbs Pond, would continue to be closed to the public.



#### *Karner Blue Butterfly Conservation Easement*

The restoration and maintenance of the pine barrens ecosystem on the easement would potentially support a suite of migratory birds that are declining due to habitat loss, including common nighthawk, whip-poor-will, eastern towhee, field sparrow, and prairie warbler. However, given the small size of the easement, it is unlikely to support any significant numbers of individuals of these species. We do not anticipate any management activities would have an adverse impact on any of these birds as management occurs outside of the breeding season when adults and young are mobile. There are likely to be short-term, localized, temporary disturbances during habitat management activities for the Karner blue butterfly, but we would not expect these activities to have an impact on local bird populations.

#### **Impacts on Migratory Birds Under Alternative A**

##### *Benefits*

Maintaining the three existing impoundments—Upper Peverly, Lower Peverly, and Stubbs Pond—would continue to provide habitat for a mix of open water, emergent marsh, and scrub-shrub wetland birds. According to NHFG, Stubbs Pond is unique within the Great Bay Estuary system, given its relatively large size (44 acres of freshwater wetland) and diverse emergent vegetation community. There are no other sites in coastal New Hampshire that support the amount or diversity of waterfowl documented at Stubbs Pond, particularly during the spring and fall migrations. A few shorebirds also use the refuge as stopover habitat during migration.

Grassland and shrubland dependent birds would continue to benefit from the management of 169 acres of grasslands and 26 acres of shrubland habitat. Forest birds of conservation concern, such as scarlet tanager and wood thrush, would benefit from the conservation of 659 acres of forested habitat on the refuge.

##### *Adverse Impacts*

Under alternative A, active refuge habitat management would focus on grassland, shrubland, and freshwater wetland habitats. As such, there would be less emphasis on managing and monitoring habitats for forest- and salt marsh-dependent bird species. The continued management for a mosaic of different habitat patches, and maintenance of the current trail and access road system under this alternative, would have an adverse impact on interior forest and interior grassland birds. Road and edge habitat increase predation, parasitism by brown-headed cowbirds, and facilitate invasive plant colonization. Use of trails and access roads cause repeated disturbance to wildlife, reducing quality of habitat for breeding and migratory stopover. Although we would continue to employ prescribed fire and mowing to manage grasslands and mechanized equipment for shrub management under alternative A, we would lack the staff to assess and monitor the structural characteristics of these habitats and to modify our management accordingly. Hence there would be less capacity to practice adaptive management if our wildlife objectives are not met.

#### **Impacts on Migratory Birds Under Alternative B**

##### *Benefits*

Benefits to grassland birds (with a focus on upland sandpipers) would increase through more intensive management of fewer grasslands. We would remove hedgerows, fencing, and structures in the Weapons Storage Area to enlarge individual grassland sites, and would implement best management practices for managing the fields. Increased staffing under alternative B would give the refuge a greater opportunity to employ adaptive management based on our ability to measure vegetative responses to our management and by monitoring year-to-year bird responses to habitat conditions. Due to consolidation of habitats, there would be a reduction of forest and grassland edge habitat, resulting in a slight benefit to interior forest and grassland migratory birds.

The salt marsh sparrow population on the refuge and around Great Bay would benefit from a greater focus on the health of the refuge's salt marsh habitat. The emphasis on invasive plant removal and maintaining native shrubs would benefit migratory birds, by providing a more nutritional native fruit and insect supply.

The amount of managed shrubland would increase by 33 acres under alternative B. These shrubland acres would be managed more actively for native plant diversity, dense cover, and biological integrity and health. This more active management would benefit shrubland birds and potentially the New England cottontail.

#### *Adverse Impacts*

The removal of the deteriorating Lower Peverly Pond Dam would have limited negative impact on birds, since few birds use this impoundment, as compared to Upper Peverly and Stubbs Ponds. Restoration of this section of Peverly Brook should enhance conditions for riparian birds, waterfowl, and waterbirds as native vegetation develops. Benefits to birds foraging in Stubbs Pond would be enhanced by removing a source of erosion and sedimentation that affects downstream water quality. Shrub habitat under alternative B would be consolidated and managed more actively for native plant diversity, dense cover, and biological integrity and health, resulting in improved benefits to shrubland birds and potentially New England cottontail. The proposed wild turkey hunt has the potential to disturb nesting birds. We would attempt to minimize such disturbance by establishing hunting zones and identifying excluded areas.

#### **Impacts on Migratory Birds Under Alternative C**

##### *Benefits*

Under alternative C, there would be a moderate increase in benefits for forest dependent birds as grassland and shrubland habitats are allowed to succeed naturally to forest. An additional 193 acres of forest would be managed over the existing 659 acres resulting in an increase in the quantity and quality of interior forested habitat on the refuge, with reduced edge effects and fragmentation.

The removal of Stubbs Pond impoundment and its restoration could result in an additional 44 acres of estuarine habitats including salt marsh. This would provide a significant benefit to species dependent on these habitats, including the salt marsh sparrow. Similar to alternative B, a greater focus on salt marsh habitats and the salt marsh sparrow populations around Great Bay would further benefit this species.

##### *Adverse Impacts*

Grassland and shrub dependent birds would be adversely affected, more so than under alternatives A and B, as these habitats would not be maintained through active management. We anticipate that the 169 acres of grasslands and the 26 acres of shrubland would succeed to forest over time, and the species associated with these habitats—especially the area dependent upland sandpiper—would decline and eventually disappear from the refuge. This would potentially occur within the 15-year timeframe of the CCP.

With the removal of all the impoundment infrastructure, we anticipate a decline in open water and freshwater marsh birds on the refuge, such as waterfowl, herons, marsh wrens, and rails, and an increase in salt marsh dependent species, such as salt marsh sparrow, and possibly scrub-shrub (riparian and wetland edge) bird species. The loss of this open water habitat would have a major regional impact on freshwater birds. According to NHFG, Stubbs Pond is unique within the Great Bay Estuary system, given its large size (44 acres of freshwater wetland) and established population of wild rice. There are no other places in coastal New Hampshire that draw in the amount and diversity of waterfowl documented at Stubbs Pond, especially mallards and black ducks during



spring and fall migration (Ed Robinson, Waterfowl Biologist, NHFG, personal communication).

The potential impacts from a proposed turkey hunt are similar to alternative B, although with fewer areas excluded from hunting under alternative C, the impacts to migratory birds are likely to be higher.

## Fish Impacts

### Impacts on Fish that Would not vary by Alternative

#### *Benefits*

There are no federally listed fish species known to occur on the refuge. However, the refuge works with the Service's Fisheries Program to maintain self-sustaining, healthy populations of migratory fish. At Great Bay Refuge these species include American eel, alewife, and blueback herring. In addition to maintaining fish passage, where feasible, refuge management supports other Fisheries Program goals, including protecting the health of aquatic habitats. We would continue to work with our partners at the abutting the Tradeport to prevent any accidental spills from airport operations that might harm water quality and fisheries on the refuge.

#### *Adverse Impacts*

We would continue to be concerned about fish health due to contaminated sediments within the Peverly Brook system, specifically within Upper Peverly Pond. The sediments are routinely sampled and the trend indicates that the level of contaminants in the sediment is declining over time (see appendix I). However, the levels remain a concern. The Service would continue to monitor the sediments and water quality within the Peverly Brook system to work toward improved health of the water quality for fisheries and other aquatic organisms. An American Rivers (2002) report cautions that removing a dam where contamination is a concern can have a negative effect on the stream community. They state that in some cases, dams create a useful barrier between fish populations up- and downstream of a dam because it may prevent contaminated populations from migrating. Additionally, they state that dams can prevent the establishment of invasive species either above or below the structure. Overall, it is important to keep in mind the context of our project area. Peverly Brook is a relatively short drainage (approximately 1.5 miles) and has minimal spawning habitat due to the steep topography adjacent to the brook. Therefore, refuge lands would never be a major contributor to migratory fish populations in the bay.



Duane Raver/USFWS

*American eel*

*Karner Blue Butterfly Conservation Easement*

There are no fish species on the Karner Blue butterfly easement.

**Impacts on Fish Under Alternative A***Benefits*

Migratory fish, including alewife, American eel, and blueback herring coming into Great Bay, continue to use the fish passage into Stubbs Pond, although the effectiveness of the fish ladder is not entirely known. American eels are able to migrate furthest up Peverly Brook to Upper Peverly Pond. The deep pools in Upper and Lower Peverly Ponds serve as coldwater refugia for eels in summer. We would continue to monitor fish population and fish passages under alternative A. However, this monitoring would continue to be sporadic and occur when staffing and resources allow.

*Adverse Impacts*

The adverse impacts on fisheries would be similar to those described under adverse impacts on “Hydrological Systems and Water Quality under Alternative A.”

**Impacts on Fish Under Alternative B***Benefits*

Under alternative B, we would evaluate the effectiveness of the Stubbs Pond fish passage to ensure it maximizes benefits to migratory fish. We would anticipate long-term benefits to fish from routine sediment and water quality sampling in the Peverly Brook system. We would respond responding to any concerns identified by this sampling, including the remediation of contaminated sediments, where that can feasibly occur. Other indirect benefits include the reduction of impervious surface as we continue to remove facilities in the former Weapons Storage Area.

The proposed removal of Lower Peverly Brook Dam would eliminate one barrier to fish passage and would enhance and restore habitat for riverine and cold water fish along approximately 1,100 feet of brook. We would expect reestablishment of other aquatic riverine species that occur up and downstream of this section of brook to occur within a relatively short timeframe. While we would not expect major changes in fish population sizes of migratory species that already occur in Peverly Brook following dam removal, we would expect fish species already known for the area to move into formerly inaccessible reaches (Stanley and Doyle 2003). The removal of impoundment infrastructure would be preceded by sediment, water quality, and invasive plant sampling, the installation of sediment controls and barriers, and remediation as feasible.

*Adverse Impacts*

The removal of the Lower Peverly Pond Dam is the only proposed refuge management activity that would have a direct impact on the fisheries resource and the result is expected to be mixed. In general, warm water fish species would decline dramatically due to the loss of ponded water, although there would be potential benefits to cold water riverine fish. This impact is likely to be permanent to warm water fisheries and warm water aquatic macroinvertebrates in the pond location. According to Stanley and Doyle (2003), “Riverine species should increase at the expense of reservoir taxa...Organisms present in the reservoir prior to removal may be washed downstream or stranded during surface water drawdown.” In their studies of small dam removals in Wisconsin, these authors observed that fish and macroinvertebrates adapted to slow moving water and silty sediments gave way to riverine taxa within a year of removal. The recovery of riverine aquatic taxa reflected both recolonization of individuals that had previously resided upstream or downstream from the dam and successful reproduction within the newly created habitat. This recovery may be somewhat

limited in our management situation since the vicinity of Upper Peverly Pond precludes upstream riverine restoration as does the decision not to remove Stubbs Pond. On the other hand, beaver are very active in the area, and are creating ponded waters that would provide additional habitat for fish and aquatic macroinvertebrates.

The timing, duration, size, and amount of sediment release are the factors most likely to directly affect fish and other aquatic organisms downstream in the short term. These impacts are poorly understood and recovery rates are difficult to predict (Thomson et al. 2005). Generally, as reported by Thomson et al. (2005), the expectation is that downstream sediment deposition would continue until a relatively stable channel and floodplain have been developed above the former dam, after which particle sizes in downstream reaches would gradually increase as excess sediment decays (Pizzuto 2002).” In summarizing studies on small Wisconsin dam removal projects, Thomson et al. (2005) discuss that even severely depleted benthic communities often recover rapidly once sediments are flushed from the system. They report that other authors suggest that small dam removals are unlikely to have long-term negative impacts on downstream benthic communities as long as highly vulnerable species are not present. We would expect that fish and macroinvertebrate diversity and populations downstream would recover rapidly, and would be largely unaffected over the long term in our project area. Our assessment is primarily due to the small size of the area affected and the sediment controls we would put in place to minimize extreme flushing and depositions.

We anticipate that the long-term benefits associated with restoration of a stream corridor, including that area which was impounded, would outweigh the relatively short-term ecological impacts of downstream sedimentation following removal (Thomson et al. 2005).

### **Impacts on Fish Under Alternative C**

#### *Benefits*

The removal of all impoundment infrastructures in the Peverly Brook system would provide the maximum benefit to fish passage compared to alternatives A and B. The restoration of the entire 1.5 mile Peverly Brook would be expected to enhance passage for American eel. An American Rivers report (2002) emphasizes that when the goal is promoting fish migration and passage, it is important to consider restoration of the entire system, and not fragmented pieces. Other benefits to fish and aquatic resources are identified under alternative B.

#### *Adverse Impacts*

In addition to those adverse impacts identified in alternative B, fully restoring the Peverly Brook system would potentially contribute contaminants to Herods Cove and Nannie Island, which hosts more than half the bay’s oyster population. The refuge would continue to monitor contaminants in Upper Peverly and only restore after contaminants are mitigated. However, restoration may expose contaminants that are otherwise buried. A restored hydrological connection to the bay would also increase the potential for future contaminants from airport operations (e.g., the de-icing pad located at the head of the Peverly drainage) to reach eelgrass beds. In the short term, the removal of Stubbs Pond dam would dramatically reduce the existing spawning habitat for alewife, which prefer flooded pool habitat. However, over the long term, the removal of the dam and ladder would likely enhance passage for alewife. Furthermore, some alewife spawning habitat may be restored through beaver-created ponds, but it is difficult to predict where and when this might occur.

## Federally Threatened and Endangered Species Impacts

### Impacts on Federally Threatened and Endangered Species that Would not vary by Alternative

#### *Karner Blue Butterfly*

By 2003, no native populations of the federally listed endangered Karner blue butterfly remained in New England. The last native population occurred in the Concord pine barrens in Concord, New Hampshire, and was extirpated in 2000. This population lived in a powerline right-of-way and in the grassy median strips at the Concord Airport. It declined from an estimated 3,700 butterflies in 1983, to 219 butterflies in 1991, and finally to less than 50 in 1994 (Peteroy 1998). A reintroduction program was started in 2001 at Concord with the donor population from the Saratoga Airport in New York. The State of New Hampshire has since successfully reintroduced the butterfly into the wild. For 5 years in a row (2005 to 2009), NHFG biologists have documented Karner blue butterflies surviving on their own in the wild at the Concord pine barrens (Holman 2010 personal communication). The Karner blue butterfly conservation easement, administered by the Great Bay Refuge, is central to this success.

In addition to the federally listed Karner blue butterfly, the Concord pine barrens, including the Karner blue butterfly easement, support other State-listed rare species: frosted elfin butterfly, Persius duskywing skipper, and wild lupine. The Service, along with its state partners, are implementing the Karner blue butterfly recovery plan (USFWS 2003), with the long-range goal to remove the species from the Federal list of endangered and threatened wildlife and plants.

#### *New England Cottontail*

The Great Bay Refuge is within the historic range of the New England cottontail, a species that is being considered for Federal listing due to population declines. This is New England's only native rabbit. It is dependent on early successional habitat such as old fields, shrub thickets, young generating forests, and other shrubby areas. Habitat loss is one of the primary causes of the population decline, caused by widespread clearcutting for agriculture in the 1800s, followed by natural succession to forest in the late 1900s. Another major factor in the cottontail's population decline was the introduction of eastern cottontail (a Mid-Atlantic species) for recreational hunting in the mid 1900s, as the agricultural lands were being abandoned. The introduced cottontail outcompeted the native cottontail in the newly open landscape, and still has a competitive advantage to present day. Habitat fragmentation and major barriers, such as highways, have also reduced connectivity of the remnant populations, making them vulnerable to inbreeding and random events.

Traditionally, recovery efforts begin when the species is placed on the threatened or endangered species list. Since listing is a several year process, those years are a lost opportunity for recovery. In a paradigm shift, the Service's goal is to work aggressively on voluntary recovery efforts through land conservation and habitat management to prevent listing of the New England cottontail.

The refuge would continue to work with other Service personnel and partners, including GBRPP, to conserve ecologically important lands for the New England cottontail and Karner blue butterflies. In chapter 3, under "Land Protection Focus Areas," we identify a set of focus areas we propose to evaluate within the next 5 years. Under alternatives B and C, we would work with our partners to identify additional lands needing permanent protection through fee acquisition, conservation easement, or management agreement. The goal of our land protection activities would be to provide benefits to both Karner blue butterflies and New England cottontails by protecting habitat from development and providing corridors that facilitate genetic exchange within and among populations.

### Impacts on Federally Threatened and Endangered Species Under Alternative A

#### *Karner Blue Butterfly*

The Karner blue butterfly population would continue to benefit from the Service's support of NHFG's habitat management and Karner blue butterfly captive rearing, release, and monitoring program. Under current management, we would continue to rely heavily on NHFG to carry out this program.

#### *New England Cottontail*

The refuge has had little previous involvement in New England cottontail conservation and management, in part because State and Federal partners are just beginning to implement a conservation strategy for the species. Since New England cottontail do not currently occur on the refuge, we anticipate no adverse impacts under current management.

### Impacts on Federally Threatened and Endangered Species Under Alternative B

#### *Karner Blue Butterfly*

Benefits to the Karner blue butterfly population are expected to be significantly greater under alternative B, through increased emphasis on conserving additional pine barrens habitat, more coordinated habitat management, greater support for monitoring and evaluation of the captive rearing and release program, and more onsite outreach and education about Karner blue butterflies and pine barrens ecology. NHFG would continue to take the lead on all aspects of Karner blue butterfly conservation and habitat management.

#### *New England Cottontail*

The refuge would be more actively engaged in working with partners to conserve lands that support existing populations of New England cottontail in coastal New Hampshire. In addition, the refuge would place more emphasis on the management of shrubland habitat for a variety of shrubland dependent species, but with a particular focus for potential habitat to benefit the cottontail. Specifically, the refuge would create and maintain shrub habitat within a portion of the former Weapons Storage Area, which could be used as a captive rearing site or a reintroduction site for the cottontail if it fits in with regional efforts to restore the cottontail to its former range. We would work with the New England Cottontail Working Group and GBPP, to continue to evaluate this potential for New England cottontail to either occupy or be reintroduced to shrubland on the refuge (e.g., alder thickets).

### Impacts on Threatened and Endangered Species Under Alternative C

#### *Karner Blue Butterfly*

Same as alternative B.

#### *New England Cottontail*

Under alternative C, our emphasis would be on natural ecosystem processes, which includes allowing the grasslands and shrublands to succeed naturally to forest cover. We would remove all structures, including fencing, within the former Weapons Storage Area. Therefore, under this alternative the refuge would not be a potential captive rearing or reintroduction site for New England cottontails.

### Biological Integrity, Diversity, and Environmental Health Impacts

### Impacts on Biological Integrity, Diversity, and Environmental Health that Would not vary by Alternative

#### *Benefits*

The 1997 National Wildlife Refuge System Improvement Act stated that in administering the System, the Service shall "... ensure that the biological integrity, diversity, and environmental health of the System are maintained..."



Biological integrity refers to the composition, structure and function of habitats, communities or ecosystems and the natural processes that shape them. Biological diversity is the variety of all living things. Environmental health encompasses the structure, function and health of soil, water, air, and other abiotic elements. We evaluated the impacts of our management actions on perpetuating, maintaining, or restoring the biological integrity, diversity, and environmental health of the refuge.

Under all the alternatives we would protect roosting sites, and active and potential nest sites for bald eagles and osprey, restrict public access to sensitive salt marsh and shoreline natural communities, and protect rare plants and exemplary natural communities. The refuge would remain closed to wheeled vehicles (with the exception of wheelchairs), motorized vehicles, dog walking, jogging, horseback riding, and camping, because of their potential to cause soil compaction, vegetation loss, or disturbance to wildlife and to provide greater protection of biological integrity, diversity, and environmental health on the refuge. Controlled deer hunting would be continued under all alternatives to manage a high deer population in the absence of any natural predators. Managing the deer population would reduce invasive plants, reduce the likelihood of disease (such as Lyme and chronic wasting disease), and contribute to healthier and more diverse plant communities.

Aquatic mammals, especially beaver and muskrat, would likely be affected differently across the alternatives depending on the extent of impoundment management or restoration of the Peverly Brook drainage. Our recent bat surveys indicate an opportunity to focus more on their habitat needs, which is addressed under alternatives B and C. Under all the alternatives the refuge would maintain forested and scrub-shrub wetlands and non-impounded freshwater wetlands that support amphibians and reptiles. We have little information on its invertebrate populations at Great Bay Refuge; without more data we cannot fully assess our management impacts.

In addition, our separate discussions of impacts to soils, water quality and hydrologic systems are pertinent here, since these are components of biological integrity, diversity, and environmental health.

#### *Adverse Impacts*

The unchecked spread of invasive plants threatens the biological diversity, integrity and environmental health of refuge habitats. In many cases, these plants have a competitive advantage over native plants and form dominant cover types, reducing the availability of native plants as food and cover for wildlife. Under all alternatives we would continue to survey for invasive plants, avoid transporting invasive plants elsewhere on the refuge, control existing populations, and educate the public about these invaders. Rapid response to small infestations is the most effective way to protect environmental health.

The control of invasive plant species has the potential to cause some short-term environmental health impacts with the use of herbicides. However, this would be offset by careful use of such herbicides and by the long-term benefits to biological integrity, diversity, and environmental health by removing invasive plants and maintaining native vegetation. All the alternatives propose some maintenance of trails and management roads, although the extent varies under each alternative. Roads and trails by their nature cause compaction, loss of vegetation, disturbance to wildlife, fragmentation, and cause edge effects, such as increased predation and invasive plants.



#### *Karner Blue Butterfly Conservation Easement*

Our management goal at the easement is to restore the biological integrity, diversity, and environmental health of the pine barrens ecosystem, with a focus on restoring the Karner blue butterfly population. Other rare species would benefit from this management, including several rare moths and a suite of migratory birds. There are also several mammal, amphibian, and reptile species on the refuge, including the hognose snake (State-listed endangered) and black racer (State-listed threatened). Although they would not be the focus of our management, they would also benefit.

### **Impacts on Biological Integrity, Diversity, and Environmental Health Under Alternative A**

#### *Benefits*

Under alternative A, we would continue to enhance biological integrity, diversity, and environmental health by removing former military infrastructure (buildings and roads), restoring these sites to natural communities, and allowing numerous small forest openings to revert to forests. We would also continue the monitoring and mitigation of contaminated sites, as funding allows.

#### *Adverse Impacts*

The refuge would continue to rely on partners to restore and maintain the biological integrity of intertidal and shallow estuarine habitats in the estuary. Under alternative A, we would maintain all three impoundments, providing minimal opportunity to restore environmental health and biological integrity to the Peverly Brook watershed. Our habitat management activities, including prescribed burning and mowing of approximately 195 acres of grasslands and shrublands affect the natural succession of vegetation by artificially keeping it from becoming forest. Generally, grasslands and shrublands would not occur in this amount and distribution under natural conditions. However, these activities are intended to increase the diversity of certain declining grassland and shrubland species, such as grassland nesting birds and New England cottontail. The trade-off would be a decline of diversity of forest-dependent birds, amphibians, reptiles, mammals, and invertebrates.

### **Impacts on Biological Integrity, Diversity, and Environmental Health Under Alternative B**

#### *Benefits*

Given landscape-scale negative impacts to their habitats and populations, bats and New England cottontails would likely benefit under this alternative, through active management of a portion of the former Weapons Storage Area. We would modify some of the bunkers as habitat for bats and the surrounding area would be managed as potential shrub habitat for New England cottontail. The co-occurrence of oak-hickory forests (roosting habitat) with open wetlands or grasslands provides ideal foraging habitat for breeding and migrating bats.

We would remove unnecessary buildings in the former Weapons Storage Area and at Fabyan Point and restore these areas to natural vegetation, thus improving the overall environmental health and biological integrity of the refuge.

#### *Adverse Impacts*

Under alternative B, we would reduce our grassland and shrubland management by 43 acres, which would succeed to forest habitat. While this would reduce habitat for grassland and shrubland-dependent species, it would reduce edge and benefit forest-dependent interior wildlife species.

Under alternative B, some contaminated sediments would remain within the Upper Peverly Pond impoundment. More routine sediment and water

quality sampling and the development of a protocol to periodically assess the health of this impoundment and options for restoring or remediating the impoundment would offset the short-term adverse impacts from maintaining the impoundment as is.

A modest expansion of the trail network would cause some adverse impacts to environmental health, specifically soil compaction and loss of vegetation. However, we would offset these impacts by maintaining pedestrian only access, improving the interpretive signs, offering public use programs to make visitors aware of the sensitivity of refuge habitats, and by using best management practices during construction of new trails.

As described under soils and vegetation, the proposed expanded hunting seasons could have minor impacts to the biological integrity, diversity, and environmental health of the refuge through greater soil compaction, trampling of vegetation, and spreading of invasive plants. However, deer hunting would help reduce the deer population, which could minimize the potential for overbrowsing of native vegetation by deer.

Long-term benefits to intertidal and other estuarine habitats and species, including oysters and eelgrass, would increase significantly under alternative B. The refuge would work actively with partners to protect and restore the health and function of these off-refuge habitats and to restore populations of oysters and eelgrass, including populations in Herods Cove and around Nannie Island. Partial restoration of the biological integrity of the Peverly Brook system would occur through removal of the Lower Peverly Pond Dam.

### **Impacts on Biological Integrity, Diversity, and Environmental Health Under Alternative C**

#### *Benefits*

We expect the greatest benefit to biological integrity, diversity, and environmental health under alternative C, because we would focus on the restoration of natural processes. Specifically, we expect an increase in biological integrity and environmental health, but a decrease in biological diversity, as grasslands and extensive shrublands are eliminated. In addition to the impacts described under alternative B, the biological integrity, diversity, and environmental health of the intertidal and estuarine habitats off the refuge in Great Bay would likely improve with the restoration of Stubbs Pond. Natural communities and rare plants would be a focus under this alternative through restoration of habitats, control of invasive plants, and reliance on natural ecological processes. Restoration of the biological integrity of the entire Peverly Brook system would occur through the removal of all impoundment infrastructures and restoration of environmental health through removal of contaminated sediments and invasive species prior to dam removals. We would further improve the overall biological integrity, diversity, and environmental health of the refuge by removing all remaining structures in the former Weapons Storage Area and at Fabyan Point and the restoration of many existing refuge management roads to native vegetation.

By restoring natural processes and ecological function, we expect refuge habitats and wildlife would retain the greatest resiliency to adapt to climate change stressors. Restoration of a large continuous forested habitat (including removal of many access roads) would also reduce the need for invasive plant control and increase habitat quality for wildlife species, particularly rare plants, migratory birds, bats, and amphibians and reptiles.

### *Adverse Impacts*

There would be some loss of biological diversity as grasslands and shrublands are allowed to succeed naturally to forest. However, we expect a proportionate increase in nonvertebrate species, such as amphibians, reptiles, and insects. This would be offset by benefits to the biological integrity of forest communities as natural disturbances and ecological processes would create a mosaic of habitat conditions.

The removal of all the existing impoundments under alternative C could result in direct transportation of contaminants to Great Bay and Herods Cove with possible impacts to existing eelgrass, oyster beds, clam flats, and other marine life. Similar to alternative B, a modest expansion of the trail network would cause soil compaction and loss of vegetation in those areas. The proposed trail to the Margeson Estate and Woodman Point would introduce some wildlife disturbances and potential for invasive plants. The potential impacts to biological integrity, diversity, and environmental health from expanded hunting are similar to those under alternative B, although the degree of adverse impacts would likely be higher given the level of hunting proposed under alternative C.

## **Public Use and Access Impacts**

### **Impacts on Public Uses and Access that Would not vary by Alternative**

#### *Benefits*

Great Bay Refuge would remain open to five of the six priority wildlife-dependent public uses: wildlife observation, nature photography, hunting, environmental education, and interpretation. The refuge would remain closed to fishing for reasons described below. According to a 1997 public opinion survey for New Hampshire—*Statewide Outdoor Recreation Needs Assessment*—one of the most popular activities in New Hampshire is wildlife observation (NHOEP 2007). This coincides with our focus on wildlife observation, photography, and hunting as the highest priority public uses for the refuge.

The refuge would continue to be open from sunrise to sunset and the trail network would remain open to pedestrian-only use. We would maintain the 2-mile Ferry Way Trail and the 0.5-mile Upper Peverly Trail under all the alternatives. We propose a modest adjustment of the trail layout under alternative B and a slight increase in the number of trails and extent of the trail network under alternative C. Under all alternatives, the 2-day deer hunting season would continue to be held each fall with support from NHFG. An expansion of the hunting program is proposed for alternatives B and C, subject to further NEPA analysis.

### *Adverse Impacts*

Under all the alternatives we would continue to prohibit fishing, given the uncertainty about contaminated sediments in the Peverly Brook system and the sensitivity of salt marsh and other habitats along the shores of Great Bay. We would work with our partners around Great Bay to guide anglers to more appropriate fishing locations. Alternatives B and C propose to work with NHFG to evaluate closing the shoreline of the refuge to waterfowl hunting to protect sensitive shoreline, estuarine, and intertidal habitats in Great Bay Estuary, especially for oysters and eelgrass. This decision would be subject to further NEPA analysis.

### *Karner Blue Butterfly Conservation Easement*

The 29-acre Karner blue butterfly easement is small in size and receives only a modest number of visitors. We would maintain the existing 0.4-mile pedestrian trail under all the alternatives. Wildlife observation and photography and environmental education and interpretation are the primary public uses that would occur here. Hunting and fishing are not available at this site.

## Impacts on Public Uses and Access Under Alternative A

### *Benefits*

We do not envision any additional benefits under alternative A that are not already addressed under impacts that would not vary by alternative.

### *Adverse Impacts*

Under all the alternatives the refuge is open from sunrise to sunset. However, due to lack of staffing under alternative A, the refuge office would remain closed and there would only be an information kiosk available. This would limit our ability to provide quality wildlife-dependent outdoor experiences and to gauge the public's interest in the use of the refuge. The refuge would also continue to be closed to other public uses during the 2-day fall deer hunt; however this has not previously, to our knowledge, caused hardship or conflict with other user groups. During our CCP scoping process we did hear from at least one constituent who thought there should be no hunting on the refuge.

### *Karner Blue Butterfly Conservation Easement*

We do not envision any additional benefits or adverse impacts under alternative A that were not already addressed under impacts that would not vary by alternative.



Greg Thompson/USFWS

*Wildlife viewing blind at Peverly Pond Trail*

## Impacts on Public Uses and Access Under Alternative B

### *Benefits*

Under alternatives B and C, a new refuge office and visitor contact station would be built, with up to four refuge staff, significantly increasing the interaction of visitors with refuge personnel. In addition, the hiring of a visitor services specialist would significantly increase the environmental education and interpretive offerings both on and off the refuge. The two existing trails would be enhanced with improved observation blinds and wildlife viewing platforms and better signage and

interpretive displays, enhancing the experience of refuge visitors. A modest expansion of these two trails, including a new trail at Fabyan Point, would further enhance visitor opportunities and experiences.

Expansion of hunting opportunities to include wild turkey and fall bow season for deer would be pursued; however these actions would require further NEPA analysis. Working with partners on Great Bay who also provide wildlife observation and environmental interpretation opportunities, such as the GBNERR, to create and distribute more information would enhance the public's understanding and experience in and around the Great Bay Estuary.



### *Adverse Impacts*

Much of the refuge would continue to be closed to public access due to the sensitivity of habitats and to avoid disturbances during critical periods, such as bird nesting season. By enhancing the existing trail network—through a modest expansion with better interpretive materials and facilities—we believe the public would have a better experience visiting those areas that are open to the public. With an expanded hunting program, there would possibly be additional days when the refuge is closed to other uses. However, the refuge

*Interpretive kiosk at refuge parking lot*



Greg Thompson/USFWS

would remain open to the public most of the year. To further reduce potential visitor conflicts, our proposal for additional hunting seasons would be weekdays only within specific zones and excluding trails. Karner Blue Butterfly Conservation Easement

Under this alternative we would create more interpretive materials for the self-guided trail, the existing kiosk, and our Web site. In addition, we would install a kiosk on the east entrance, in an area already disturbed by the existing road right-of-way. Its placement would not affect butterfly habitat. These improvements would enhance the experience of visitors to the easement and raise awareness about the ecology of the pine barrens. The Service and NHFG law enforcement officials would coordinate site visits to enforce against

unauthorized uses such as motorized recreation. This would reduce impacts to resources and minimize conflicts with approved public uses.

### **Impacts on Public Uses and Access Under Alternative C**

#### *Benefits*

In addition to alternative B, we propose a new trail that would provide public access into areas—such as Woodman Point—that were previously closed to the public. Hunting opportunities would also be expanded beyond those proposed under Alternative B. These would include a fall archery season for wild turkey (following the State season) and a fall archery season for deer that would also span the State season (mid-September to mid-December). The other difference in the proposed hunting seasons under alternative C is that the refuge would be open to hunting 7 days a week and there would be fewer excluded areas.

#### *Adverse Impacts*

In addition to alternative B, we anticipate higher visitor conflicts under alternative C, since we propose opening up of the refuge to hunting 7 days a week from mid-September to mid-December.

#### *Karner Blue Butterfly Conservation Easement*

Same as alternative B.

### **Cultural Resources Impacts**

#### **Impacts on Cultural Resources that Would not Vary by Alternative**

Regardless of the alternative, the Service is responsible for managing and protecting archaeological and historic sites found on national wildlife refuges. The consequences of past, current, and proposed management on cultural resources are the same across all alternatives. Any management actions with the potential to affect cultural resources would require review by the refuge



manager, as well as review by the Service's RHPO in consultation with the State of New Hampshire SHPO, as mandated by section 106 of NHPA. Therefore, determining if particular actions within an alternative have the potential to affect cultural resources is an ongoing, well-established, and regulated process that would occur during the planning stages of any proposed projects.

As indicated in chapter 3, we have initiated consultation with SHPO to determine the National Registry eligibility of the structures in the former Weapons Storage Area and the Fabyan Point cabins, and to determine the fate of the Margeson Estate, which is already listed on the National Registry. The results of the consultation will determine what specific management options and/or mitigation measures are available to us.

#### *Karner Blue Butterfly Conservation Easement*

There are no known historical or archaeological sites on the easement. However, under all alternatives, we would compile current cultural resource inventories and identify additional survey work needed to protect cultural resources in conjunction with habitat management and other site planning. We would also support NHFG's efforts to seed lupine, where possible, rather than digging and planting, to avoid potential conflicts with cultural resources.

#### **Impacts on Cultural Resources Under Alternative A**

The Margeson Estate is on the National Register and is currently in poor condition. Under alternative A, we would continue very limited maintenance of the site due to a lack of resources and staffing. It is predicted that, without extensive renovations, the buildings would continue to deteriorate in place. This would result in a total loss of the site's integrity.

#### **Impacts on Cultural Resources Under Alternative B**

We would plan to complete consultation with SHPO within 1 year of CCP approval. That consultation will determine whether additional structures on the refuge are eligible for the National Register. All ineligible buildings would be removed. If any of the structures are determined eligible, we would evaluate management options and/or mitigation measures with SHPO. For the Margeson Estate, we have indicated to SHPO that our preferred alternative is recording the site and then demolishing the buildings. While this would represent a loss of the physical structures, we would fulfill all requirements to document the buildings to ensure historical information is preserved. If we pursue demolition of eligible buildings, including the Margeson Estate, with SHPO concurrence, additional NEPA analysis may be required.

#### **Impacts on Cultural Resources Under Alternative C**

Same as alternative B.

## **Cumulative Impacts**

### **Air Quality**

Very high ozone levels occur in the seacoast regions of Maine, New Hampshire, and Massachusetts during the summer due to a combination of factors (e.g., dense population, local pollution sources, downwind of sources outside the region). On average, southern New Hampshire and coastal Maine experience 3 to 5 days per year of very unhealthy ozone levels, with some years (e.g., 1988) that are much worse. Air quality issues in the region are largely the result of the influx of airborne pollutants originating from industrial regions, metropolitan centers, and transportation corridors located upwind, primarily in the Midwest and Mid-Atlantic regions. The region's air quality is also affected by other factors, including industrial sources, transportation emissions, acid rain, weather patterns, and climate changes (Wake et al. 2004).

We predict only a negligible adverse impact on regional air quality from refuge activities due to the small number of staff, limited management activities, the relatively small size of the refuge (1,103 acres), and the fact that motorized public access is only allowed on the entrance road. Management actions and public uses at the refuge would contribute negligibly to regional vehicle emissions compared to other nearby emission sources. The refuge receives approximately 30,000 visitors each year compared to the 70,000 vehicles per day that travel on the nearby Spaulding Turnpike (Route 16) (VHB 2007). In addition, the adjacent Pease International Tradeport supports more than 36,000 aircraft flights per year (US DOT 2010; <http://www.gcr1.com/5010web/airport.cfm?Site=PSM>; accessed May 2011). Also, PSNH operates three 50-megawatt steam boilers (two coal boilers and one wood boiler) nearby in the town of Newington, which emit greenhouse gases.

With our partners, we would continue to contribute to improving air quality through cooperative land conservation and management of natural vegetation and wetlands. Great Bay Refuge is the largest block of protected land on Great Bay Estuary. Maintaining refuge land in natural upland vegetation or wetlands, assures these areas would continue to filter out many of the air pollutants harmful to humans and the environment. This is especially important in a region that is already densely developed with residential, industrial, and commercial buildings.

We would also support community proposals to develop a regional bike trail. This trail would encourage alternative transportation to regional destinations, including the refuge, which could reduce regional greenhouse emissions from motorized vehicle use.

#### **Karner Blue Butterfly Conservation Easement**

As described under regional air quality impacts above, the primary air quality impacts from habitat management activities come from prescribed burns. Collectively, the Service and NHFG burn approximately 70 acres per year, most on abutting city of Concord lands. These prescribed fires follow a detailed burn plan that addresses air quality issues. The Karner blue butterfly easement is surrounded by residential and commercial development, so maintaining the pine barrens as open space in an already densely developed region benefits air quality. In addition, the adjacent Concord Municipal Airport serves approximately 90,000 flights per year (US DOT 2010; <http://www.gcr1.com/5010web/airport.cfm?Site=CON>; accessed May 2011). Compared to these air quality impacts from aircraft, the refuge's cumulative impact is negligible.

#### **Water Quality and Health of the Great Bay Estuary**

Since the refuge lands were transferred from the Air Force to the Service, there has been a continual improvement in water quality. Any contaminants released by the military during their tenure that seeped into soils and water have been in decline according to routine sampling (see appendix I).

In chapter 2, we describe the environmental indicator trends for the Great Bay Estuary. We anticipate continued cumulative improvements in these trends from both refuge-specific actions and our partnerships off-refuge. Refuge-specific actions include removal of deteriorating impoundment infrastructure, continued sediment sampling and monitoring of water quality, remediation of contaminated sediments where feasible, and control of invasive plant species. The ability to implement each of these management actions varies across alternatives. We would continue to work with our conservation partners, including GBRPP, PREP, and GBNERR, to maintain and improve water quality in the Great Bay Estuary. Specifically, our collaborative efforts on land conservation and restoration of oysters and eelgrass in the Great Bay Estuary would lead to improved health of this ecosystem.

From 1990 to 2005, land consumption in the coastal watersheds of New Hampshire increased from 0.15 to 0.22 acres of impervious surface per person. Increasing rates of land consumption per person is an indicator of sprawl-type development, which is a threat to the habitats, wildlife, and environmental health of the watershed. The town of Newington has one of the highest levels of impervious surfaces, increasing from 0.694 acres/person in 1990 to 1.330 acres/person in 2005 (NHEP 2006). Great Bay Refuge is the largest unfragmented block in the town of Newington and is the largest block of protected land on the bay. We anticipate no net increase in the amount of impervious surface on the refuge based on the combination of building demolition and construction of a new headquarters/visitor contact station and maintenance facility. On over 1,000 acres of the refuge, we are preventing further degradation of regional water quality by maintaining natural vegetation, which has the ability to filter out sediments and pollutants.

Our proposal to remove one or more dams in Peverly Brook (the number depends on the alternative selected) would begin to reestablish a natural hydrological flow in the system. It would serve as a demonstration area for other potential stream restoration projects in the region and as a research and monitoring site for effects of these restoration activities on migratory fish, and oyster and eelgrass beds.

Evaluating opportunities for additional land acquisition would potentially lead to the permanent protection of undeveloped lands with high natural resource value, including those lands and waters that would further enhance the water quality and health of the Great Bay ecosystem.

#### **Trust Resources and Biological Integrity, Diversity, and Environmental Health**

All of the alternatives would maintain or improve Service trust resources and biological integrity, diversity, and environmental health on the refuge and in the region, although to varying degrees. The combination of our management actions with other organization's actions could result in significant, beneficial cumulative effects by

- increasing the conservation and management of federally and State-listed threatened and endangered species and other species of concern and associated habitats, through acquisition of ecologically important uplands and wetlands;
- using adaptive management and the best science available to manage and promote regionally important habitats and natural communities;
- removing deteriorating or unnecessary infrastructure and restoring areas, thereby improving soil, water, and air quality;
- controlling invasive plants and animals that are not native to the area; and
- partnering with GBNERR and others to offer educational and interpretive programs that help citizens improve the biological integrity and environmental health of the Great Bay Estuary.

#### **Karner Blue Butterfly Conservation Easement**

Similarly, on the easement our work with partners could result in a significant, beneficial cumulative effect by continuing to work with the NHFG and other partners to conserve and manage the federally listed endangered Karner blue butterfly and the ecologically significant pine barrens ecosystem.

#### **Socioeconomic Environment**

We expect none of the proposed alternatives to have a significant adverse cumulative impact on the economies of the town of Newington and Rockingham County. Nor would any of the alternatives alter the demographic or economic characteristics of the local community. We expect a net benefit to the adjacent

community by providing a natural setting for solitude, enjoyment of nature and wildlife, and outdoor recreation opportunities.

The actions we propose would neither disproportionately affect any communities nor damage or undermine any businesses or community organizations. Any new land acquisition that we propose would involve only willing sellers, and would be a result of a detailed analysis of ecological important lands in the coastal watersheds. New acquisitions would be in partnership with other conservation entities and would be consistent with local and regional conservation plans, such as the PREP plan, NHWAP, the Land Conservation Plan for New Hampshire's Coastal Watersheds, and other similar plans. Regardless of which alternative we select we would continue to pay refuge revenue sharing Payments to the communities where the refuge is located.

Fully funding the additional staffing in alternatives B and C would make a small, incremental contribution to the employment and income in the local community. With increased staffing and more emphasis on environmental education, interpretation, and wildlife observation on the refuge, we expect public use of the refuge to increase, thereby increasing the number of days visitors spend in the area and, correspondingly, the level of visitor spending in the local community. Interpretation of the cultural and land use history of the area—including the former military operations and farming and fishing legacies—would offer a unique interpretive experience for local residents and visitors from afar.

Our existing and expanding partnerships with local, State, and Federal entities around the Great Bay Estuary are key to successful conservation outcomes and building public understanding and support for this work. With onsite staffing, as proposed under alternatives B and C, we would be more responsive to our partners, to visitors to the refuge, and to local communities, schools and colleges, and others interested in learning more about Great Bay. Not all priority public uses would be available on the refuge, however we would guide people to other places around Great Bay



*Gulls on Great Bay*

Greg Thompson/USFWS

that are more suitable to their recreational interest. More outreach could also positively affect land use decisions outside the refuge by local governments and private landowners, and thus, lead to benefits to the regions biological integrity, diversity, and environmental health.

### **Karner Blue Butterfly Conservation Easement**

Similar to the Great Bay Estuary, our partnerships are key to successful pine barrens management and restoration of a viable Karner blue butterfly population. The actions we propose would neither disproportionately affect any communities nor damage or undermine any businesses or community organizations. Any new land acquisition that we propose would involve only willing sellers, and would be a result of a detailed analysis of ecological important lands in the Concord pine barrens region.

We expect none of the proposed alternatives to have a significant adverse cumulative impact on the economy of the town or county in which the Karner blue

butterfly conservation easement lies. Nor would any of the alternatives alter the demographic or economic characteristics of the local community. Interpretation of the ecology of the pine barrens and its inhabitants would offer a unique experience to visitors and residents of the region — highlighting an important part of the natural legacy of this region.

## Global Climate Change

Department of the Interior Secretarial Order 3226 (January 16, 2009) states that “there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decisionmaking...This Order ensures that climate change impacts are taken into account in connection with Departmental planning and decisionmaking.” Additionally, it calls for the incorporation of climate change considerations into long-term planning documents, such as this CCP.

The Wildlife Society (TWS) published a technical review report in 2004 titled “Global Climate Change and Wildlife in North America” (Inkley et al. 2004). The TWS report interprets results and details from such publications as the IPCC reports (1996 to 2002) and describes the potential impacts and implications on wildlife and habitats. It mentions that projecting the impacts of climate change is hugely complex because not only is it important to predict changing precipitation and temperature patterns, but more importantly, to predict their rate of change, as well as the exacerbated effects of other stressors on the ecosystems. Those stressors include loss of wildlife habitat to urban sprawl and other developed land uses, pollution, ozone depletion, exotic species, disease, and other factors.

The effects of climate change on populations and range distributions of wildlife are expected to be species specific and highly variable, with some species benefiting and others vulnerable to extirpation or extinction. Generally, the prediction in North America is that the ranges of habitats and wildlife will generally move upwards in elevation and northward as temperature rises (Inkley et al 2004, Rodenhouse et al, in press). The TWS report, however, emphasizes that developing precise predictions for local areas is not possible due to the scale and accuracy of current climate models, which is further confounded by the lack of information concerning species-level responses to ecosystem changes, their interactions with other species, and the impacts from other stressors in the environment. In October 2010, GBNERR and the Great Bay Stewards were awarded a grant to develop specific climate change predications for the Great Bay watershed and develop conservation and outreach adaption strategies.

To help meet the climate change challenge the Service drafted a *Climate Change Strategic Plan* (USFWS 2009b). The plan employs three key strategies to address climate change: adaptation, mitigation, and engagement. The Association of Fish and Wildlife Agencies developed guidance for states as they update and implement their respective wildlife action plans (AFWA 2009). This publication — Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans and Other Management Plans — also includes strategies that will help conserve fish and wildlife species and their habitats and ecosystems as climate conditions change. The broad spatial and temporal scales associated with climate change suggest that management efforts that are coordinated on at least the regional scale will likely lead to greater success.

Our review of proposed actions in this CCP suggests that two activities may contribute negligibly to stressors affecting regional climate change: our grassland mowing and prescribed burn program and our use of vehicles and equipment for refuge management and administration. We discuss the direct and indirect impacts of those activities elsewhere in chapter 4. We also discuss measures to minimize the impacts of both. With regards to our equipment and facilities, we are trying to reduce our carbon footprint wherever possible by using



alternative energy sources and energy saving appliances, driving hybrid vehicles, and using recycled or recyclable materials, along with reduced travel and other conservation measures. We mow or burn once a year, affecting less than 150 acres under any alternative. Alternative C outlines the most aggressive measures for addressing climate change by minimizing our carbon footprint and greenhouse gas emissions from management activities and maximizing resiliency of natural communities. In our professional judgment, most of the management actions we propose would not exacerbate climate change in the region or project area.

The TWS report provides 18 recommendations to assist land and resource managers in meeting the challenges of climate change when working to conserve wildlife resources (Inkley et al. 2004). Their position is that if land and resource managers collectively implement these recommendations, then cumulatively there would be a positive impact of addressing climate change. We discuss our actions relative to addressing some of these recommendations:

- *Recognize Climate Change as a Factor in Wildlife Conservation*  
The Service is taking a major role among Federal agencies in distributing and interpreting information on climate change. There is a dedicated Web site to this issue at: <http://www.fws.gov/home/climatechange/> (accessed May 2011), which links to the Service's recently released Strategic Plan for Climate Change. The strategic plan includes two key elements: Landscape Conservation Collaboratives and a National Fish and Wildlife Climate Adaptation Strategy; both elements bring together conservation partners to address climate change in a concerted effort. Strategies for adapting to and mitigating climate change are included in this CCP. Specific steps taken by the refuge will help reduce our greenhouse gas emissions, including using energy efficient equipment and vehicles where feasible, building and maintaining any structures using sustainable, green building technologies, conduct energy audits, and other strategies. In addition, we will rely on the habitat and species vulnerability assessments and other climate change research developed by the Northeast Climate Impacts Assessment and the Manomet Center for Conservation Science.
- *Manage for Diverse Conditions*  
The habitat management actions described in chapter 3 are intended to promote healthy, functioning native habitats, to protect biological integrity, and maintain the resiliency within these systems to adapt to changing conditions. We will implement an adaptive management approach as new information becomes available.
- *Do Not Rely Solely on Historical Weather and Species Data for Future Projections without Taking into Account Climate Change*  
Historical climate, habitat and wildlife conditions are less reliable predictors as climate changes. For example, there may be a need to adjust breeding bird survey dates if migratory birds are returning earlier to breed than occurred historically. A 3-week difference in timing has already been documented by some researchers. We are aware of these implications and plan to build these considerations into our IMP and AHWP so that we can make adjustments accordingly. Under alternatives B and C, with presence of onsite staff, we would prioritize climate change monitoring (such as phenology, timing of bird migrations, flooding regimes, and sea level rise).
- *Expect Surprises, Including Extreme Events*  
This CCP has incorporated extreme events (such as drought and increasing fire frequency) into future management strategies. We would continue to incorporate new information in future planning with the development of HMP, IMP, and Visitor Use Plans.

■ *Reduce Nonclimate Stressors on the Ecosystem*

The objectives of our habitat management program are to maintain and enhance the biological integrity, diversity and health of refuge lands. Objectives to restore at least a portion of Peverly Brook to stream habitat and to manage habitats for native vegetation would help maintain resilience in the face of climate change. Alternative C would maximize this recommendation by restoring ecological function and natural processes to much of the refuge.

■ *Maintain Healthy, Connected, Genetically Diverse Populations*

Small isolated populations are more prone to extirpations than larger, healthy, more widespread populations. Larger tracts of protected land facilitate more robust species populations and can offer better habitat quality in core areas. We would continue to work with our many conservation partners at the State and regional levels to support and complement restoration and protection efforts around the Great Bay Estuary and in the Concord pine barrens.

■ *Translocate Individuals*

It may sometimes be necessary to physically move wildlife from one area to another to maintain species viability. However, this tool has potential consequences and should only be used in severely limited circumstances as a conservation strategy. The Service supports the captive rearing and release of the Karner blue butterfly in the Concord pine barrens and is working with State and Federal partners to evaluate the feasibility of restoring New England cottontail to the Great Bay Refuge, specifically within the former Weapons Storage Area.

■ *Protect Coastal Wetlands and Accommodate Sea Level Rise*

We would continue to work with our conservation partners around the Great Bay Estuary and in coastal New Hampshire to protect coastal habitats. Refuge lands are not expected to be inundated by projected sea level rise due to its elevation. Because of this, the refuge may serve as an important corridor for movement of plants and animals in relation to climate change impacts. The area of the refuge most at risk from sea level rise is Stubbs Pond. We would work with partners to establish monitoring sites to measure the timing and extent of sea level rise in Great Bay Estuary. We will use the information gathered from these monitoring sites to adapt management to reduce the threat and maintain critical natural resources in the estuary.

■ *Reduce Likelihood of Catastrophic Events Affecting Populations*

Increased intensity of severe weather can put wildlife at risk. While the severe weather cannot be controlled, it may be possible to minimize the effects by supporting multiple, widely spaced populations to offset losses. We can help reduce this risk by managing for diverse conditions; biological integrity, diversity and environmental health; and connected genetically diverse populations. Under all alternatives, the refuge would work with regional partners to conserve and manage sufficient large patches of high quality habitat that are connected by suitable travel corridors. This is a main focus of the Service's newly formed North Atlantic LCC.

■ *Prevent and Control Invasive Species*

Climate change may increase opportunities for invasive species to spread because of their adaptability to disturbance. Invasive species control will be essential, including extensive monitoring and control to preclude larger impacts. Invasive species control is a major initiative within the Service. The Northeast Region, in particular, has taken a very active stand. In chapter 2, we describe the current extent of invasive species on the refuge and in chapter 3 we include strategies common to all alternatives for controlling existing and future invasive plant infestations. We also describe monitoring and inventorying strategies to protect against any new infestations.

■ *Account for Known Climatic Conditions*

Monitoring key resources through predictable short-term periodic weather phenomenon, such as El Niño, can aid in future management efforts. We plan to develop a monitoring program that would help us evaluate our hypotheses, assumptions, and successes in achieving objectives, as well as help us make future management decisions. Any restoration activities or pro-active habitat management actions would be carefully planned and their effectiveness monitored and documented so we can use this information in future management decisions.

■ *Select and Manage Conservation Areas Appropriately*

The establishment of refuges, parks and reserves is used as a conservation strategy to try to minimize the decline of wildlife and habitats in North America. Decisions on locating future conservation areas should take into account potential climate change and variability. For example, it is suggested that decisions on new acquisitions consider the anticipated northward migrations of many species, or the northern portion of species ranges. Managers of existing conservation lands should consider climate change in future planning. We would continue to work with our conservation partners in coastal New Hampshire and in the Concord Pine Barrens to identify and protect areas that maintain connectivity and biological integrity in the face of climate change and other stressors.

■ *Ensure Ecosystem Processes*

Managers may need to enhance or replace diminished or lost ecosystem processes. Manually dispersing seed, reintroducing pollinators, treating invasive plants and pests, are examples used. Our habitat goals and associated objectives include an emphasis on restoring at least a portion of Peverly Brook to stream habitat by removing impoundment infrastructures, encouraging natural forest communities, removing structures and restoring areas within the former Weapons Storage Area, and controlling invasive plant species. Alternative C would maximize this recommendation by restoring natural processes in most habitats on the refuge.

■ *Use Monitoring and Adaptive Management*

Managers should monitor climate and its effects on wildlife and their habitats and use this information to adjust management techniques and strategies. Given the uncertainty with climate change and its impacts on the environment, relying on traditional methods of management may become less effective. We agree that an effective and well-planned monitoring program, coupled with an adaptive management approach, will be essential to dealing with the future uncertainty of climate change. We have built both aspects into our CCP. We would develop a detailed step-down IMP designed to test our assumptions and management effectiveness in light of on-going changes. With that information in hand, we would either adapt our management techniques, or reevaluate or refine our objectives as needed.

**Relationship Between  
Short-term Uses of the  
Human Environment  
and Enhancement of  
Long-term Productivity**

In this section, we examined the relationship between local, short-term uses of the human environment and maintaining the long-term productivity of the environment. By long-term, we mean that the impact would extend beyond the 15-year period of this CCP.

Under all alternatives, our primary aim is to maintain or enhance the long-term productivity and sustainability of natural resources on the refuge, in the State of New Hampshire, and in the New England/Mid-Atlantic ecoregion. The alternatives strive to conserve migratory birds and fish, the federally listed endangered Karner blue butterfly, and other species of concern and the habitats that they depend on. The construction of a new refuge headquarters building/visitor contact station and maintenance facility represents a loss of long-term

productivity in a relatively small area, although it is on a site already disturbed as part of the Weapons Storage Area. However, staff at the visitor contact station will conduct outreach to the public about local, regional, and national conservation issues. Environmental education and interpretation programs launched from the facility would be designed to encourage visitors to be better stewards of our environment. Encouraging members of the public to support conservation efforts can ultimately lead to long-term benefits for the environment. We believe that our management actions, including control of invasive plant species, restoring at least a portion of Peverly Brook to stream habitat, managing for native vegetation, and enhancing habitats for rare species such as the Karner blue butterfly and New England cottontail, would have short-term adverse impacts, but enhance long-term productivity of the refuge. Habitat management practices that mimic ecological and sustainable processes optimize the maintenance and enhancement of the biological diversity, integrity, and environmental health of those habitats for the long term.

In summary, we predict that the alternatives would contribute positively in maintaining and enhancing the long-term productivity of the refuge's natural resources with sustainable beneficial cumulative and long term benefits to the environment surrounding the refuge with minimal inconvenience or loss of opportunity for the American public.

## Unavoidable Adverse Effects

Unavoidable adverse effects are the effects of those actions that could cause harm to the human environment and that cannot be avoided, even with mitigation measures. All of the alternatives would result in some minor, localized, unavoidable adverse effects. For example, any new construction, prescribed burns, or control of invasive species would produce minor, short-term, localized adverse effects. However, none of those effects would rise to a considerable level and would have long-term beneficial impacts. Furthermore, all of those impacts would be mitigated with best management practices, so none of the alternatives would cause significant, unavoidable cumulative impacts.

Some habitat types on the refuge would be adversely affected. Under alternative C, the removal of all impoundment infrastructure, and the restoration to stream habitat, would change the amount of impounded, open water over the long term. However, this change would likely be gradual and would eventually follow natural cycles influenced by beaver.

As we noted previously, many of the habitat and facility construction projects in the alternatives have a certain level of unavoidable adverse effects, especially during the actual construction. Those effects are mitigated to some degree by the use of practices and precautions that safeguard water quality, avoid sensitive or irreplaceable habitats, or time the actions or include features to avoid or minimize impacts on fish and wildlife. The adverse effects generally are short-term and more than offset by the long-term benefits to fish and wildlife, habitats, biological integrity and diversity, and environmental health.

Proposed public uses may have unavoidable adverse effects on vegetation, soils, and wildlife. However, we minimize these impacts to the extent possible by allowing only pedestrian use on designated trails (except during hunting), limiting access to less sensitive areas, and minimizing impacts through best management practices in trail design. Alternatives B and C, in varying degrees, would have adverse impacts to a certain segment of the public that does not desire any change in current habitat management or public use programs. Some of these impacts on certain individuals or neighbors are unavoidable, but our responsibility is to provide equal opportunities to the American public, not a select few. We believe we have sought a fair balance in minimizing and mitigating adverse impacts while optimizing wildlife conservation and also providing excellent recreational opportunities to the public.

## **Potential Irreversible and Irretrievable Commitments of Resources**

Irreversible commitments of resources are those which cannot be reversed, except perhaps in the extreme long term or under unpredictable circumstances. An example of an irreversible commitment is an action which contributes to a species' extinction. Once extinct, it can never be replaced. No irreversible commitments of resources are predicted as a result of management activities on Great Bay Refuge.

In comparison, irretrievable commitments of resources are those which can be reversed, given sufficient time and resources, but represent a loss in production or use for a period of time. In our professional judgment there are a few actions proposed that could be considered irretrievable and primarily relate to the construction of administrative and visitor facilities, such as buildings, roads, and trails. They are considered irretrievable because in the future, any facility we construct could potentially be dismantled and the site restored; however, while standing, they represent a loss in habitat productivity.

We identify the resource impacts of constructing these activities earlier in chapter 4. In our professional judgment, the overall local and regional benefits to the human environment far outweigh the loss of productivity. These infrastructures would be located within an area already heavily disturbed and hardened by previous military activity, the new building construction would be more energy efficient and designed to recycle resources to the extent possible, and outreach and communications with the public would be greatly facilitated. In summary, we predict that none of these actions would result in a significant impact on the human environment.

## **Environmental Justice**

President Clinton signed into Executive Order No. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" on February 11, 1994, to focus Federal attention on the environmental and human health conditions of minority and low income populations, with the goal of achieving environmental protection for all communities.

The order directs Federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high, adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The order is also intended to promote nondiscrimination in Federal programs substantially affecting human health and the environment, and to provide minority and low-income community's access to public information and participation in matters relating to human health or the environment.

The U.S. EPA Office of Environmental Justice defines it as follows:

Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental law, regulations, and policies. EPA has this goal for all communities and persons across this Nation. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decisionmaking process to have a healthy environment in which to live, learn, and work (<http://www.epa.gov/environmentaljustice>; accessed August 2011).

We believe, based on our socioeconomic and environmental consequences analysis, that none of our proposed alternatives would place a disproportionately high, adverse environmental, economic, social, or health effects on minority or low-income persons. None of the identified socioeconomic and environmental impacts would be localized nor be placed primarily or unequally on minority and low-income population persons who reside near the refuge. The local town



and county would bear very minor adverse effects and some beneficial effects if the refuge is managed under any of the three proposed alternatives. Adverse impacts, such as anticipated minor increases in traffic and related emissions due to visitation and negligible contributions to local mobile source air emissions from refuge equipment and vehicles, would not disproportionately affect minority and low-income populations compared to other segments of the general population. Beneficial impacts include maintaining natural vegetation that improves air and water quality through filtering, paying refuge revenue sharing payments to the town of Newington to offset property tax losses, and providing enhanced and free public uses under alternative B and C.

Before we make any decisions to make major changes in habitat management or the environment we always inform all of our publics, equally, and our programs and facilities are open to all who are willing to adhere to the established refuge rules and regulations. We do not discriminate in our responses for technical or practical information on conservation issues or when providing technical assistance in managing private lands. Additionally, all refuge uses proposed under the alternatives would be open to all members of the public. The Service is also an equal opportunity employer.

### Summary of the Impacts of the Alternatives

The following table 4.2 summarizes the benefits and adverse impacts we described above in chapter 4 for specific resources or programs proposed for Great Bay Refuge under each of the alternatives. For our discussion on cumulative impacts, the relationship between short-term uses of the human environment and enhancement of long-term productivity, unavoidable adverse impacts, potential irreversible and irretrievable commitments of resources, and environmental justice, please refer to the chapter 4 narratives above.

*Black duck*



Tim Williams

Resources	Management Focus		
	Alternative A— Current Management	Alternative B— Emphasis on Habitats and Focal Species (Service Preferred)	Alternative C— Emphasis on Natural Processes
<b>Air Quality</b>	<p>We would continue current, and adopt new, energy efficient practices including the use of hybrid vehicles and compact fluorescent lighting.</p> <p>Negligible adverse effects from burning and/or mowing up to 195 acres of grasslands/shrublands each year on the refuge. We would use prescribed fire on approximately 60 out of 169 acres of grasslands each year. We would follow a prescribed burn plan that minimizes smoke impacts on the neighboring airport and addresses other air quality issues.</p> <p>Negligible contribution to regional vehicle emissions from approximately 30,000 refuge visitors each year.</p> <p>Minimal windborne dust from refuge gravel roads.</p> <p><i>Kamer Blue Butterfly easement:</i> On average, we would burn 1 to 2 acres annually at the easement. NHFG burns another 60 to 70 acres annually on nearby city of Concord lands. The refuge and its partners follow a prescribed burn plan to minimize smoke impact on neighboring Concord airport and to address other air quality issues.</p> <p>There are no buildings or motorized visitor access on the easement.</p> <p>Overall, negligible regional air quality impact given nearby public road network and adjacent Concord municipal airport.</p>	<p>Similar to A, we would continue energy efficiency practices.</p> <p>The construction of a new energy efficient headquarters/visitor contact station and maintenance facility would provide long-term air quality benefits through use of energy efficient and green technology. Some short-term adverse impacts are likely during the construction phase and/or during demolition of unnecessary facilities, but we would use best management practices to reduce and mitigate this impact.</p> <p>Negligible adverse effects from burning and/or mowing up to 152 acres of grasslands/shrublands each year. Approximately 60 of the 98 grassland acres would be managed annually using prescribed fire, a modest increase compared to alternative A. Similar to alternative A, we would follow prescribed burn plan.</p> <p>Negligible increase in regional vehicle emissions, as compared to regional sources, anticipated from a projected 10 percent increase in visitation.</p> <p>Minimal windborne dust from refuge gravel roads. Slight short-term increase in windborne dust and other particles from demolition of remaining buildings in the Weapons Storage Area and structures at Fabyan Point, removal of Lower Peverly Pond Dam, and restoration of these sites.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative A</p>	<p>Similar to B, we would continue energy efficiency practices and construct a new energy efficient headquarters/visitor contact station and maintenance facility.</p> <p>Long-term air filtration and carbon sequestration would be modestly higher due to an increase in forest cover and reduced grassland and shrubland.</p> <p>Reduction in any adverse impacts from prescribed burning and mowing by eliminating management of grasslands and shrublands at Great Bay.</p> <p>Negligible increase in regional vehicle emissions anticipated from a projected 10 to 12 percent increase in visitation.</p> <p>Slight reduction in windborne dust and other airborne pollutants from vehicles with closure of several management access roads.</p> <p>Slight short-term increase in windborne dust and other particles from demolition of remaining buildings in the Weapons Storage Area and other unnecessary structures, the removal of all impoundment infrastructures, and restoration of these sites.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative A</p>
<p align="center"><b>Impacts that do not vary between the alternatives</b></p> <p>None of our proposed refuge management activities should adversely affect regional air quality. None would violate EPA standards and each would comply with the Clean Air Act. Management actions and public uses at the refuge would contribute a negligible increase to regional emissions. Under all the alternatives, we would continue to maintain trails for pedestrian, non-motorized and non-wheeled recreational uses only (except for the entrance road and parking lot).</p>			

Resources	Management Focus		
	Alternative A— Current Management	Alternative B— Emphasis on Habitats and Focal Species (Service Preferred)	Alternative C— Emphasis on Natural Processes
<b>Hydrologic Systems and Water Quality</b>	<p>We would continue to largely rely on partners to restore and maintain water quality within the Great Bay Estuary.</p> <p>We would minimize amount of impervious surface on the refuge by continuing to remove buildings and structures in the former Weapons Storage area and maintaining natural vegetative cover on nearly 1,103 acres.</p> <p>We would continue to maintain all three impoundments and therefore have a limited ability to restore hydrologic function and improve water quality within the Peverly Brook system.</p> <p>Due to lack of staffing, we would have limited ability to routinely monitor sediments and water within the impoundments for contaminants and to implement any remediation or restoration of water resources.</p> <p>The U.S. Air Force would continue long-term monitoring of groundwater wells.</p> <p><i>Kamer Blue Butterfly easement:</i> We do not anticipate any water quality or hydrology impacts on the easement due to its topography and that it only supports one small stream.</p>	<p>Under alternative B, we would take a greater role in conserving ecologically significant lands around the Great Bay Estuary in partnership with GBRPP, thus protecting the health of the estuary.</p> <p>We would also have a greater role and opportunity to improve and maintain water quality in the Great Estuary through restoration of oyster reefs and eelgrass beds off-refuge.</p> <p>The removal of the 7-acre Lower Peverly Pond impoundment would restore stream habitat and improved hydrologic function along a portion of Peverly Brook. Upper Peverly and Stubbs Ponds would remain, and therefore there would not be a full restoration of hydrologic function. A protocol would be developed for ongoing assessment of Upper Peverly Pond impoundment.</p> <p>Removal and control of invasive plants (especially brittle waternymph) would improve water quality.</p> <p>Enhanced sediment and water quality sampling in the Peverly Brook system would lead to improved water quality in the long-term and would alert the refuge to potential threats to water quality (e.g., such as from nearby airfield). Similar to alternative A, the U.S. Air Force would continue long-term groundwater monitoring.</p> <p>Some potential risks to water quality from treatment of aquatic invasive plants, mitigated by using only approved herbicides and best management practices and long-term benefits to hydrologic function through removal of invasive plants</p> <p>Development of new trails, a projected 10 percent increase in visitation, and the construction of a new headquarters/visitor contact station and maintenance facility also have the potential to impact water quality. We would use best management practices during the construction and demolition of any public use facilities and buildings to reduce water quality and hydrology impacts.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative A</p>	<p>In addition to alternative B,</p> <p>The removal of all three impoundments—Upper Peverly Pond, Lower Peverly Pond, and Stubbs Pond—would offer the best opportunity to restore hydrologic function to the entire Peverly Brook system.</p> <p>Sediment contamination and other water quality issues (such as invasive aquatic plants) would be remediated to the point we do not feel it would jeopardize human and ecological health. There is the greatest potential for contaminants to enter Peverly Brook under this alternative.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative A</p>
	<p><b>Impacts that do not vary between the alternatives</b></p> <p>None of our proposed refuge management activities should adversely affect regional water quality. None would violate Federal or State standards for contributing pollutants to water sources; each would comply with the Clean Water Act.</p>		

Resources	Management Focus		
	Alternative A— Current Management	Alternative B— Emphasis on Habitats and Focal Species (Service Preferred)	Alternative C— Emphasis on Natural Processes
<b>Socioeconomic Environment</b>	<p>Given the lack of current staffing at the refuge, we contribute negligibly to the local economy in terms of refuge staff jobs, income, expenditures, and purchases of goods and services for refuge activities.</p> <p>Cost of community services studies show that open space versus development is more cost-effective to towns.</p> <p><i>Kamer Blue Butterfly easement:</i> The easement is not owned in fee by the Service so we would not pay refuge revenue sharing payments.</p>	<p>Filling the four refuge staff positions would minimally increase benefits for the local economy in jobs, income, and expenditures.</p> <p>Construction of a new refuge headquarters/visitor contact station and maintenance facility would provide short-term income to the local economy for labor, materials, and services.</p> <p>Enhancing refuge programs would increase public use by approximately 10 percent each year, thereby increasing their expenditures in the local economy. This increase, however, would remain negligible in the context of the surrounding local communities.</p> <p>We anticipate an increase in biological work and a need for more seasonal technicians and hiring of local contractors or other sources to assist with building demolition, dam removal, and site restoration, providing additional income into the local economy.</p> <p>The proposed hunt expansion may increase hunting-related expenditures in local communities, however the anticipated number of hunting visits to the refuge is small.</p> <p><i>Kamer Blue Butterfly easement:</i> In addition to alternative A, enhanced interpretive information and enforcement of unauthorized use would increase the quality of visitor experiences.</p>	<p>In addition to alternative B,</p> <p>We anticipate an increase in visitation by approximately 12 percent a year given the increase in public programs including expanded trail access into parts of the refuge currently closed to protecting breeding grassland and shrubland birds.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative B</p>
<p align="center"><b>Impacts that do not vary between the alternatives</b></p> <p>Regardless of which alternative we select, we will continue to pay refuge revenue sharing payments each year to the town of Newington.</p>			

Resources	Management Focus		
	Alternative A— Current Management	Alternative B— Emphasis on Habitats and Focal Species (Service Preferred)	Alternative C— Emphasis on Natural Processes
<b>Soils</b>	<p>Maintaining grasslands and shrublands and controlling invasive plants poses slight risk to soils. Prescribed fire releases nutrients back into the soil.</p> <p>The existing Lower Peverly Pond impoundment infrastructure is failing, eroding, causing downstream sedimentation, and other adverse impacts to soils.</p> <p>Alternative A offers limited ability to address existing sediment contamination in Upper Peverly Pond and elsewhere in the Peverly Brook system.</p> <p><i>Kamer Blue Butterfly easement:</i> This is a fire-dependent ecosystem so prescribed fire benefits soils by recycling nutrients. No new trails or changes in allowed uses that would compact soils.</p>	<p>Minimal soil displacement and loss would result from proposed new headquarters/visitor contact facility and on less than an acre of proposed new trails, and/or during demolition of unnecessary facilities. Soil impacts resulting from building construction partially offset by locating new building in already disturbed area.</p> <p>Removal of unnecessary buildings and other infrastructure would provide long term benefits to soil conditions; this includes potential removal of buildings in the Weapons Storage Area and at Fabyan Point.</p> <p>Restoration of approximately 5 to 10 acres of grassland with removal of roads and buildings associated with former Weapons Storage Area.</p> <p>Removal of the Lower Peverly Pond impoundment infrastructure and restoration to stream habitat would improve soil conditions by eliminating the existing soil erosion and sedimentation from the deteriorating dike.</p> <p>Greater ability to address existing and potential sediment contamination in the Peverly Brook system through monitoring and remediation, and dam removal where feasible and greater ability to manage remaining infrastructure to prevent erosion, gulling, and other adverse soil impacts.</p> <p>Maintaining grasslands and shrublands and controlling invasive plants poses slight risk to soils. Prescribed fire releases nutrients back into the soil.</p> <p>Increased annual visitation by 10 percent might result in increased trampling and soil compaction along trails and around visitor facilities. We would design our monitoring, outreach, and education programs to reduce risk.</p> <p><i>Kamer Blue Butterfly easement:</i> In addition to alternative A, a shift in emphasis from lupine seedling planting to seeding of lupine would result in less soil disturbance.</p>	<p>Long-term benefits to soils exceeds those of alternatives A and B through removal of all three impoundments and restoration of stream habitat, elimination of grassland and shrubland management, and removal of all remaining structures and unnecessary management access roads and restoring such sites to natural conditions.</p> <p>Similar to alternative B, limited soil displacement and loss would result from proposed new headquarters/visitor contact facility and on less than an acre of proposed new trails. Soil impacts resulting from building construction would be partially offset by locating new building in already disturbed area.</p> <p>As in alternative B, there would still be some localized increase in soil impacts where public access and use occurs. We would design our monitoring, outreach, and education programs to reduce risk.</p> <p>Some risk to soils remains, associated with invasive plant control using herbicides.</p> <p>In the long term, restoring native habitats and natural communities would help restore and maintain soil productivity at these sites.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative B.</p>
	<p><b>Impacts that do not vary between the alternatives</b></p> <p>Under all the alternatives, the refuge would use IPM to control invasive species, including chemical and mechanical control which have the greatest potential to adversely affect soils. We would only use mechanical control when we determine the potential for soil disturbance is low. When applying herbicides, we would use only herbicides approved by the Regional Contaminants Coordinator and only in accordance with approved rate and timing of application.</p>		



Resources	Management Focus		
	Alternative A— Current Management	Alternative B— Emphasis on Habitats and Focal Species (Service Preferred)	Alternative C— Emphasis on Natural Processes
<b>Vegetation</b>	<p>Salt marsh vegetation would continue to benefit from resource protection by limiting public access and through invasive plant monitoring and control.</p> <p>Wetland vegetation varies year to year based on water level management. Grass and shrub vegetation continue to be actively managed. Due to a lack of staff, we would have little opportunity to monitor vegetation responses to management regimes.</p> <p>Since there would only be limited, pedestrian only public access into most of the refuge, we only predict minimal impacts to vegetation.</p> <p><i>Kamer Blue Butterfly easement:</i> Restoration of pine barrens habitat, including pitch pine and wild lupine, through prescribed fire and other management provides long-term benefit to native vegetation and plant community health.</p>	<p>Benefits to salt marsh vegetation would be slightly higher than alternative A with greater visitor education about sensitivity of salt marsh communities and through enhanced monitoring of sea level rise and baseline conditions of salt marsh health.</p> <p>Grassland and shrubland vegetation would receive the most management attention. Grasslands require active and intensive management to maintain with mowing, burning, and/or clearing of woody vegetation to maintain large openings.</p> <p>Shrubland management would be less intensive as need longer rotational management intervals. Planting of shrubs may require limited seasonal activities.</p> <p>Some riparian vegetation would be restored to Peverly Brook following removal of the Lower Peverly Dam.</p> <p>We would restore approximately 30 acres of the former Weapons Storage Area to native grassland.</p> <p>More active monitoring of vegetation responses to habitat management.</p> <p>A modest expansion of trails and hunting program would have negligible impacts on vegetation. The location of the new visitor contact facility would mostly be in an already disturbed area.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative A.</p>	<p>Benefits to salt marsh vegetation will be the highest under alternative C. In addition to the strategies in alternatives A and B, under alternative C, we would restore salt marsh and other estuarine habitat to the former Stubbs Pond once the impoundment infrastructure is removed. Similarly, riparian vegetation would eventually be restored to the Peverly Brook drainage once impoundments are removed.</p> <p>Shrub and grassland plant species would decline, except in areas maintained through natural disturbances.</p> <p>Forest vegetation would benefit the most under this alternative as areas of grass and shrub are allowed to succeed naturally to forest over time. The emphasis would be on maintaining the native forest types based on site capabilities.</p> <p>Similar to B, negligible impacts to vegetation from trails and new building; benefits from closure of many refuge management roads that would no longer be necessary.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative A.</p>
<p><b>Impacts that do not vary between the alternatives</b></p> <p>Under all the alternatives we would continue to map, monitor, prioritize, and implement controls for invasive plant species across all habitat types. Control of invasive plant species offers minimal risk of damage to native grass, shrub, and forest vegetation. Herbicides would be used only under strict application regulations and procedures to ensure that only targeted plants are affected.</p>			

Resources	Management Focus		
	Alternative A— Current Management	Alternative B— Emphasis on Habitats and Focal Species (Service Preferred)	Alternative C— Emphasis on Natural Processes
<b>Migratory Birds</b>	<p>Maintenance of the three existing impoundments would continue to provide habitat for a mix of open water, emergent marsh, and scrub-shrub wetland birds.</p> <p>Grassland and shrubland birds would continue to benefit from the management of these habitats. Burning, mowing, or cutting of these habitats is timed to avoid the nesting season.</p> <p>Maintaining 659 acres of upland forest and 149 acres of forested wetland would benefit forest-dependent species of concern such as scarlet tanager, wood thrush, and Baltimore oriole.</p> <p><i>Kamer Blue Butterfly easement:</i> Restoration of pine barrens habitat would benefit a suite of species including common nighthawk, whip-poor-will, eastern towhee, field sparrow, and prairie warbler.</p>	<p>Removal of the Lower Peverly Pond Dam would have limited negative impact on water birds, since few birds use Lower Peverly Pond, compared to Upper Peverly and Stubbs Ponds.</p> <p>A greater focus on the health and status of salt marsh sparrow populations on the refuge and around Great Bay would benefit this species.</p> <p>The amount of grassland habitat would decrease by 71 acres under alternative B.</p> <p>The amount of managed shrubland habitat would increase by 33 acres and be inventoried and monitored to determine the most appropriate management regimes for birds and potentially New England cottontail. The emphasis on invasive removal and maintaining native shrubs would benefit migratory birds.</p> <p>A projected increase in visitation (10 percent) and an expanded hunting program may disturb migratory birds. To minimize this impact hunting zones would be established and all other public use would be restricted to designated trails.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative A.</p>	<p>Benefits to grassland and shrub dependent birds would decline as these habitats are not maintained through active management.</p> <p>Forest dependent birds would realize a slight increase in benefits as grassland and shrubland habitats are allowed to succeed naturally over time to forest.</p> <p>With the removal of all the impoundment infrastructure, we anticipate a decline in open water and freshwater marsh birds, such as waterfowl, herons, and rails, and an increase in salt marsh dependent species such as salt marsh sparrow and possibly scrub-shrub (riparian and wetland edge) bird species.</p> <p>As in alternative B, a greater focus on the salt marsh sparrow populations around Great Bay would further benefit this species.</p> <p>A projected increase in visitation (10 to 12 percent) and an expanded hunting program may disturb migratory birds. To minimize this impact, all public use, excepting hunting, would be restricted to designated trails.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative A.</p>
	<p><b>Impacts that do not vary between the alternatives</b></p> <p>We would continue to monitor and control invasive plant species under all alternatives. By removing invasive species and encouraging native vegetation, we would improve the quality of cover and forage for migratory birds. We would continue to prohibit public access to sensitive migratory bird habitat, including 2 acres of rocky shoreline habitat.</p>		

Resources	Management Focus		
	Alternative A— Current Management	Alternative B— Emphasis on Habitats and Focal Species (Service Preferred)	Alternative C— Emphasis on Natural Processes
Fisheries	<p>Migratory fish, including American eel, and river herring would continue to benefit from the fish passage into Stubbs Pond.</p> <p>American eel would continue to be able to migrate up Peverly Brook to Upper Peverly Pond and use the deep pools in both ponds as cold water refugia in summer.</p> <p>Stubbs Pond would continue to provide habitat for American eel and spawning river herring.</p> <p><i>Kamer Blue Butterfly easement:</i> No fisheries resources exist on the easement.</p>	<p>The removal of the Lower Peverly Pond Dam could diminish cold water refugia habitat for American eel. This might be offset by beaver damming parts of Peverly Brook, creating pools of cooler water along the drainage from Upper Peverly Pond to Stubbs Pond.</p> <p>Under alternative B, we would evaluate the effectiveness of the Stubbs Pond fish passage to ensure it maximizes benefits to migratory fish.</p> <p>Long-term benefits to fisheries would result from routine sediment and water quality sampling in the Peverly Brook system with remediation of contaminated sediments implemented where feasible.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative A</p>	<p>The removal of all impoundment infrastructures in the Peverly Brook system would provide the maximum benefit to fish passage, although there might be some loss in cold water refugia within the system with the lowering of the water levels. As in alternative B, this might be offset by beaver activity.</p> <p>Removal of Stubbs Pond Dam would result in the loss of spawning habitat for river herring.</p> <p>Removal of impoundment infrastructure would be preceded by sediment, water quality and invasive plant sampling, control and remediation as feasible to improve water quality, offering long-term benefits to fisheries and other aquatic life.</p> <p>Removal of all impoundments could result in the direct discharge of contaminants into Herods Cove and Great Bay.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative A</p>
	<p><b>Impacts that do not vary between the alternatives</b></p> <p>Under all alternatives, we would continue to work with the Pease International Tradeport to prevent silks that may impair water quality and harm fisheries on the refuge. There would also continue to be fish health concerns due to contaminated sediments with the Peverly Brook System. The refuge would continue to monitor these sediments and water quality.</p>		

Resources	Management Focus		
	Alternative A— Current Management	Alternative B— Emphasis on Habitats and Focal Species (Service Preferred)	Alternative C— Emphasis on Natural Processes
<b>Threatened and Endangered Species:</b> <b>Karner blue butterfly and New England cottontail</b>	The Karner blue butterfly population would continue to benefit from the Service's support of NHFG's habitat management and Karner blue butterfly monitoring.	Benefits to the Karner blue butterfly population are expected to be significantly greater under alternative B due to increased emphasis on conserving additional pine barrens habitat, more coordinated habitat management, greater support for monitoring and evaluation of the captive rearing and release program, and more onsite outreach and education about Karner blue butterflies and pine barrens ecology.  The New England cottontail, a candidate species, would benefit from potential new land conservation and shrub habitat management on the refuge. Also, we would consider using a portion of the refuge as a captive-rearing site for New England cottontail.	The benefits to Karner blue butterflies would be the same as alternative B.  New England cottontail would not benefit under this alternative as grassland and shrublands would be allowed to succeed naturally to forest cover.
<b>Biological Integrity, Diversity, and Environmental Health</b>	<p>We would continue to remove former military infrastructure and restore these sites to native vegetative communities.</p> <p>We would continue to rely on partners to restore and manage the biological integrity of intertidal and shallow estuarine zones just offshore of the refuge.</p> <p>We would also continue to maintain all three impoundments, which would provide minimal opportunity to restore environmental health and integrity to the Peverly Brook system.</p> <p><i>Karner Blue Butterfly easement:</i> We would continue to restore and manage the Concord pine barrens ecosystem, benefiting the Karner blue butterfly, rare moths, migratory birds, and pitch pine plant community.</p>	<p>Benefits to intertidal and other estuarine habitats and species in the Great Bay Estuary, including oysters and eelgrass, would increase significantly under alternative B. The refuge would work with partners to protect and restore the health and function of these habitats and to restore populations of oysters and eelgrass.</p> <p>Maintaining shrub and grassland habitats would provide greater habitat diversity, although with some loss of biological integrity since these habitats require active management to maintain.</p> <p>The removal of Lower Peverly Pond Dam would result in partial restoration of the biological integrity of the Peverly Brook system.</p> <p>Bats and New England cottontails would likely benefit under this alternative through active management of a portion of the former Weapons Storage Area.</p> <p><i>Karner Blue Butterfly easement:</i> Same as alternative A.</p>	<p>Similar to alternative B, we anticipate benefits to the intertidal and estuarine habitats in the Great Bay Estuary.</p> <p>Natural communities and rare plants would be a focus under this alternative through restoration of habitats, control of invasive plants, and reliance on natural ecological processes.</p> <p>Restoration of the biological integrity of the entire Peverly Brook system through removal of all impoundment infrastructure and restoration of environmental health through removal of contaminated sediments.</p> <p>We would restore and maintain natural forest conditions, which should provide natural roosting habitats for tree-dwelling bats.</p> <p><i>Karner Blue Butterfly easement:</i> Same as alternative A.</p>
<p><b>Impacts that do not vary between the alternatives</b></p> <p>Under all alternatives, we would protect roosting and nesting bald eagles, restrict public access to sensitive habitats, and protect rare plants and exemplary natural communities. We would also continue to monitor and control invasive plants species. The potential short-term impacts of herbicides for invasive plant treatment would be offset by the long-term habitat and food resource benefits of restoring native vegetation.</p>			

Resources	Management Focus		
	Alternative A— Current Management	Alternative B— Emphasis on Habitats and Focal Species (Service Preferred)	Alternative C— Emphasis on Natural Processes
<b>Public Uses and Access</b>	<p>Due to lack of staffing under alternative A, the refuge office would remain closed, providing no visitor contact facility.</p> <p>Wildlife observation and photography would continue to be the primary priority public uses.</p> <p>Two pedestrian trails (2 miles and 0.5 miles, respectively) would continue to be maintained.</p> <p>A 2-day deer hunting season would continue to be offered in the fall with support from NHFG.</p> <p><i>Kamer Blue Butterfly easement:</i> We expect that the easement would continue to receive only a small number of visitors. Priority public uses include wildlife observation, photography, environmental education, interpretation. Hunting and fishing would not be available.</p>	<p>Under alternatives B, a new refuge office and visitor contact station would be built, with up to four refuge staff, significantly increasing the interaction of visitors with refuge personnel.</p> <p>The two trails would be enhanced with improved observation blinds and wildlife viewing platforms and better signage and interpretive displays, enhancing the experience of refuge visitors.</p> <p>The hiring of a visitor services specialist would significantly increase the environmental education and interpretive offerings both on and off the refuge.</p> <p>We would pursue expansion of hunting opportunities to include wild turkey and fall bow season for deer.</p> <p><i>Kamer Blue Butterfly easement:</i> In addition to alternative A, more interpretive information and enforcement of unauthorized use would enhance visitor experiences.</p>	<p>In addition to alternative B, A new spur trail off the Upper Peverly trail that leads out to Woodman Point would provide access to more of the refuge.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative B.</p>
	<p><b>Impacts that do not vary between the alternatives</b></p> <p>Under all the alternatives we will continue to prohibit fishing, given the uncertainty about contaminated sediments in the Peverly Brook system and the sensitivity of salt marsh and other habitats along the shores of Great Bay. We will work with our partners around Great Bay to steer anglers to more appropriate fishing locations. The refuge would continue to be open to the public from sunrise to sunset.</p>		
<b>Cultural Resources</b>	<p>A lack of staff at the Great Bay Refuge provides limited opportunity to offer interpretive programs or otherwise address cultural resources.</p> <p><i>Kamer Blue Butterfly easement:</i> Cultural resources benefit from more detailed inventories and surveys prior to habitat management on the pine barrens in Concord.</p>	<p>Our environmental education and interpretive programs at the Great Bay Refuge would highlight the cultural history of the refuge lands, including historic buildings and uses.</p> <p>We would complete consultation with SHPO on all refuge buildings and determine the management options and/or mitigation measures to implement to insure compliance with section 106 of NHPA.</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative B.</p>	<p>Same as alternative B</p> <p><i>Kamer Blue Butterfly easement:</i> Same as alternative B.</p>
	<p><b>Impacts that do not vary between the alternatives</b></p> <p>Under all the alternatives, we would work with the SHPO to assess the range of options for the Margeson Estate, which is on the National Register.. On all projects, including removal of other non-essential structures at Fabyan Point and in the Weapons Storage Area, we would ensure compliance with section 106 of the National Historic Preservation Act and consult with SHPO.</p>		